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SOUTH CAROLINA EXPERIMENT STATIC

THE PLANT DISEASE BULLETIN

Issued By

The Plant Disease Survey

SUPPLEMENT 8

Diseases of Cereal and Forage Crops in the United States in 1919.

May 1, 1920.

BUREAU OF PLANT INDUSTRY

UNITED STATES DEPARTMENT OF AGRICULTURE

PLANT DISEASE SURVEY

1919

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DISEASES OF CEREAL AND FORAGE CROPS
IN THE UNITED STATES IN 1919.

Prepared by
A. G. Johnson* and R. J. Haskell.

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PRELIMINARY STATEMENT

The data on which the following summary of cereal and forage crop diseases is based were obtained from four principal sources:

1. Collaborators of the Plant Disease Survey as listed on the preceding page.
2. Crop disease specialists of the Bureau of Plant Industry.
3. Miscellaneous reports and records obtained by the Plant Disease Survey.
4. The records of the 1919 cereal disease survey conducted by the Office of Cereal Investigations, United States Department of Agriculture. This survey was made in 26 states, commencing in Alabama and Texas May 12 and 13, and ending in northern Idaho September 4.

The following table shows the states where surveys were conducted, the time of the work, and the number of fields visited in each state:

---

*Plant pathologist, Office of Cereal Investigations, temporarily transferred to the Plant Disease Survey, Bureau of Plant Industry.

Table 1. Number of fields of small grain inspected by men engaged in the cereal disease survey, 1919. Much of the information on which the summaries in the following pages are based was obtained from observations in these fields.

State	Time of Survey	Number of grain fields surveyed.			
		Wheat	Oats	Barley	Rye
New York	June 30-July 18	138	113	11	10
Pennsylvania	July 8-July 19	105	122	11	6
Maryland	June 11-July 12	164	4	--	2
Virginia	June 4-June 17	59	5	1	6
Kentucky	June 11-June 18	163	14	1	5
Tennessee	May 30-June 19	177	38	5	16
Georgia	May 14-May 28	39	23	--	3
Alabama	May 12-May 29	133	113	2	18
Texas	May 13-June 2	200	176	21	3
Oklahoma	June 3-June 10	98	33	9	1
Arkansas	June 6-June 10	12	8	--	1
Ohio	June 16-July 3	283	26	10	8
Indiana	June 16-July 19	596	254	36	28
Illinois	June 18-June 28				
	July 11-July 21	92	31	--	24
Wisconsin	July 16-Aug. 5	107	139	51	15
Minnesota	July 2-Aug. 19	520	280	111	128
Iowa	June 27-July 18	214	78	30	3
Missouri	May 26-June 28	562	101	6	16
North Dakota	Aug. 4-Aug. 8	53	11	7	1
Nebraska	June 27-July 3	67	13	4	1
Kansas	June 12-June 25	114	51	3	1
Montana	Aug. 5-Aug. 12	97	60	16	--
Colorado	June 17-July 26	154	20	22	--
Idaho	July 9-Sept. 4	283	94	32	--
Washington	July 2-Aug. 30	1081	72	43	3
California	May 19-July 18	593	109	298	6
United States	May 12-Sept. 4	6104	1988	730	305

WHEAT

Bunt caused by Tilletia laevis Kühn and T. tritici (Bjerk.) Wint.

Bunt occurred about as extensively during 1919 as the preceding year but losses from it are reported as being somewhat less on the whole. On the accompanying map are indicated the occurrence and estimated percentages of reduction in yield in the states where losses were reported. The estimated losses from bunt in 1919 are summarized in bushels in Plant Disease Bulletin, Supplement 12, 1920.

It is to be noted that, in general, the average estimated percentages of loss from this disease were comparatively low. However, in a number of states very high percentages of bunt were reported as having occurred in individual fields. California leads with 90% reported from one field, and Washington is a close second with over 80% reported in one field and an even 80% in another, both in Whitman County. The following list gives the states in the order of highest percentages of bunt reported from individual fields. The states with less than 15% as maximum percentages are omitted.

Table 2. Highest percentages of bunt reported from individual fields in 1919.

States	Highest % bunt reported	States	Highest % bunt reported
California	90.	Iowa	28.
Washington	80.	Illinois	24.
Indiana	76.	Arkansas	23.
Idaho	66.	Colorado	22.5
Georgia	60.	Alabama	20.
Kansas	50.	Oklahoma	20.
Ohio	50.	New York	16.
Kentucky	48.	Minnesota	15.
Missouri	40.	Tennessee	15.
Nebraska	32.		

It is to be noted that three of the four highest percentages are from the far west where soil infestation by bunt is known to occur; namely, from California, Washington, and Idaho. The high percentages reported from Indiana, Georgia, Kansas, and Ohio would seem to bear out the known fact that high percentages of bunt can result without soil infestation; namely, when very smutty, susceptible, untreated seed is planted under conditions favorable for the development of this disease. Such unusually high individual percentages of loss so widely scattered over the country should speak volumes to the individual farmer in emphasizing to him personally the necessity of taking all feasible precautionary measures to avoid, so far as possible, any such losses in his own fields at any time in the future.

While high individual losses are of greatest interest and importance to individual farmers, high average losses are of greatest importance to the nation as a whole. Fortunately the highest average percentages of loss from bunt in 1919 did not occur uniformily in the major wheat producing states. However, the comparatively low average percentages of loss in those states aggregate a very large total.

The somewhat lesser amount of bunt in 1919 than in the previous year is no doubt chargeable to at least two groups of causes: (1) more intelligent attention to the use of cleaner seed, either from clean seed stocks or by use of suitable seed treatments; and (2) weather conditions just preceding, at, and immediately following, seeding time.

It is well known that high soil temperatures during the early seedling stage tend to inhibit bunt infections. Further, it was noted in Montana by Jennison that "drought tended to hold down amount of infection." In Idaho Hungerford and Wade showed experimentally that, with other things equal, the amount of smut tends to vary inversely with the dryness of the soil. No doubt the rather dry, warm spring in the spring wheat area tended to keep down the amount of bunt infection there. The rather high bunt infections in individual fields, reported from this area, may possibly be attributed to unusually early sowing or to some other local condition particularly favorable to bunt development.

Table 3. Summary of cereal disease survey data on the occurrence of bunt in wheat varieties in Washington in 1919.

a. Ten or more fields surveyed of each variety.

Variety	Total No. fields surveyed.	Total No. fields smutted.	% of fields smutted.	Average % smut in smutted fields.	Average % smut in all fields surveyed.
Early Baart	144	32	22.	1.3	.29
Fortyfold	147	122	83.	3.37	2.8
Jenkins' Club	40	29	73.	4.06	2.9
Jones' Fife	92	80	87.	3.24	2.8
Little Club	19	12	63.	1.6	1.
Marquis	93	6	6.	4.3	.27
Pacific Blue Stem	145	30	21.	1.43	.29
Red Chaff	21	9	43.	4.7	2.
Red Russian	86	76	88.	9.1	8.
Turkey Red	80	57	71.	1.3	.94
Wash. Hybrid No. 63	29	25	86.	7.08	6.1
Wash. Hybrid No. 123	21	17	81.	4.23	3.4
Wash. Hybrid No. 128	80	76	95.	5.2	4.9
Wash. Hybrid No. 143	47	35	74.	8.6	6.4

b. Fewer than ten fields surveyed of each variety.

California Gem	4	4	100.	1.	1.
Coppie	2	2	100.	1.	1.
Dicklow	8	2	25.	t	t
Kinney	1	1	100.	t	t
Red Allen	3	0	0.	0.	0.
Red Fife	1	1	100.	.25	.25
Triplet	5	4	80.	5.	4.
White Australian	1	1	100.	18.	18.

Table 4. Summary of cereal disease survey data on the occurrence of bunt in wheat varieties in Whitman County, Washington, in 1919.

a. Five or more fields surveyed of each variety.

Variety	Total No. fields surveyed.	Total No. fields smutted.	% of fields smutted.	Average % smut in smutted fields.	Average % smut in all fields surveyed.
Fortyfold	83	79	95.	3.6	3.4
Jenkins' Club	9	4	44.	3.7	1.6
Jones' Fife	6	5	83.	6.9	5.7
Little Club	15	11	73.	1.3	1.
Marquis	64	4	6.	6.4	.4
Pacific Blue Stem	25	7	28.	1.4	.4
Red Chaff	20	10	45.	4.3	2.1
Red Russian	67	65	97.	9.4	9.1
Turkey Red	6	5	83.	t	t
Wash.Hybrid No. 123	14	10	71.	.5	.4
Wash.Hybrid No. 128	7	7	100.	5.	5.
Wash.Hybrid No. 143	12	11	91.	3.5	3.

b. Fewer than five fields surveyed of each variety.

California Gem	4	4	100.	1.	1.
Coppie	1	1	100.	2.	2.
Early Baart	3	0	0.	0.	0.
Kinney	1	1	100.	t	t
Triplet	1	0	0.	0.	0.

Clearly, seed treatments were practiced more extensively than the preceding year ant this of course had its share in reducing the amount of bunt. Of the 6104 wheat fields inspected by the cereal disease survey men in the 26 states visited, 2220, or 36% were found to have been sown with treated seed. These data, together with the results, are summarized in Table 5 presented and discussed later.

Information on varietal resistanceto bunt, while fragmentary, is rather promising. Melchers reports that Heald is finding Kanred somewhat resistant to bunt in Washington. Certain promising selections are also being developed at the Washington Agricultural Experiment Station.

As to field evidence, bearing on disease resistant tendencies, it is at once evident that data gathered in the state of Washington are of most value because of the extensive soil infestation by bunt that occurs in that state. This is especially true for such counties as Whitman County, Washington, where wheat raising is unusually important and soil infestation is rather

Fig. 1. Relative percentages of fields of different wheat varieties smutted in Whitman County, Washington in 1919. Data from five or more fields of each variety covered by cereal disease survey. See Table 4.

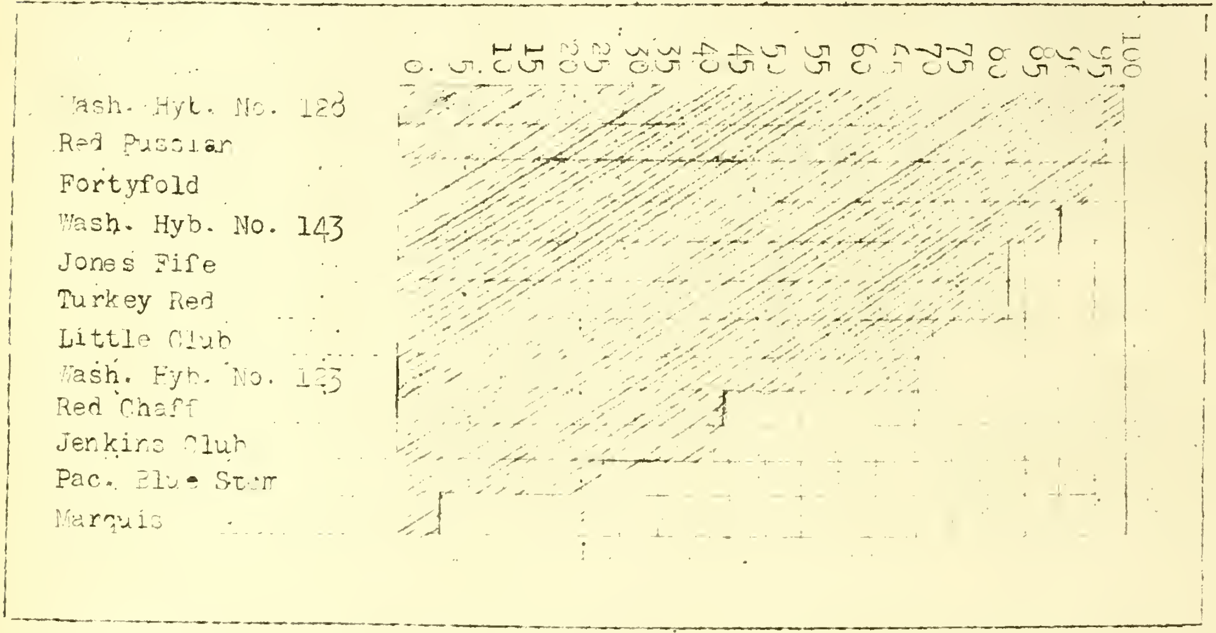
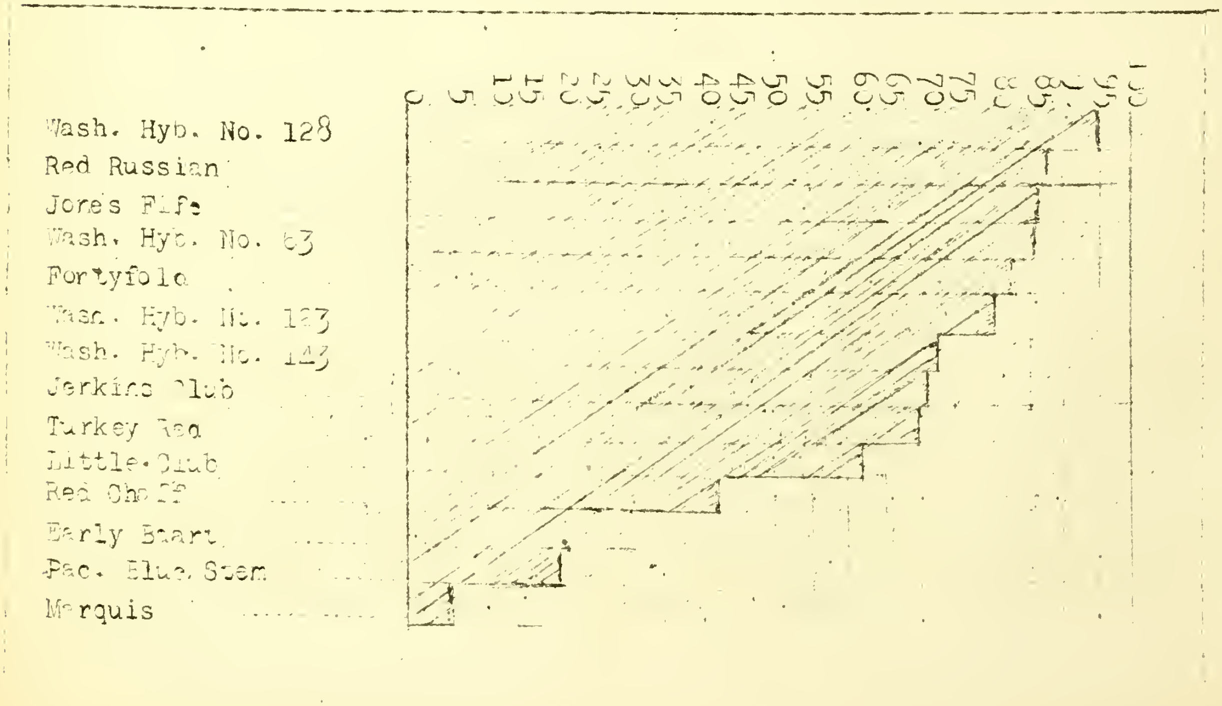


Fig. 2. Relative percentages of fields of different wheat varieties smutted in Washington in 1919. Data from ten or more fields of each variety covered by cereal disease survey. See Table 2.



general. On account of these conditions the cereal disease survey data from Washington have been gone over especially from this point of view, and the summaries indicate that certain wheat varieties tend to show some degree of resistance to bunt, at least they were found less constantly smutted than certain other varieties.

These data are summarized in Tables 3-4 and Figures 1-2. The data from Whitman County, while included in the state summaries, are also summarized separately for reasons stated above.

While it is conceded, in general, that data of this sort, for a number of reasons, are by no means as reliable as those from carefully conducted experimental tests, yet it may not be without significance that the same varieties appear at each of the two corresponding ends of the two graphs. That is, fields of Washington Hybrid No. 128 and Red Russian were found most constantly smutted and fields of Pacific Blue Stem and Marquis were found least constantly smutted. It should be added also that practically all of the bunt in Marquis was found in two fields in Whitman County where 17.5% and 8.1% respectively were recorded. Only traces of bunt were found in each of the other four fields of

Table 5. Summary of cereal disease survey data on bunt in fields inspected in 1919, sown with untreated and treated seed.

State	No. fields surveyed	No. fields with seed not treated	No. fields with seed treated	% bunt seed not treated	% bunt seed treated
New York	138	134	4	0.4	0
Pennsylvania	105	99	6	0.2	0
Maryland	164	144	20	0.8	0.3
Virginia	59	54	5	0.3	0.2
Kentucky	163	100	63	0.5	t
Tennessee	177	142	35	0.6	t
Georgia	39	13	26	6.	t
Alabama	133	65	68	1.3	t
Texas	200	171	29	0.02	t
Oklahoma	98	93	5	0.3	t
Arkansas	12	3	9	7.6	0
Ohio	283	260	23	2.1	0.3
Indiana	596	501	95	0.9	t
Illinois	92	90	2	0.3	0
Wisconsin	107	101	6	t	0
Minnesota	520	425	95	0.5	t
Iowa	214	207	7	0.5	t
Missouri	562	390	172	1.6	t
North Dakota	53	15	38	0.	0
Nebraska	67	50	17	3.	0.8
Kansas	114	93	21	1.2	t
Montana	97	83	14	0.14	0
Colorado	154	86	68	1.9	t
Idaho	283	128	155	4.7	1.7
Washington	1081	108	973	2.9	2.5
California	593	329	264	2.	2.5

Marquis found smutted out of the total of 93 inspected in the state. Further, the two fields showing 80% bunt, previously referred to, were in both cases Red Russian. A number of high percentages of bunt were also found in Washington Hybrid No. 128, Washington Hybrid No. 143, Jones Fife, Turkey Red, and less commonly in other varieties.

Similar data from other states apparently do not show outstanding constancy, either in the frequency with which the different varieties were found smutted, or in the percentages of bunt when smutted. This is as might be expected, since in other states than Washington soil infestation by bunt is absent or less common and hence, as a result there is no constancy in exposure to infection. However, the summarized data are suggestive from a number of points of view and are therefore given in the accompanying tables.

One rather outstanding question suggested by the data is as to why Marquis is smutted more commonly in most of the central and eastern states than in Washington. The data are not at hand as to whether or not this variety, when found smutted in Washington and elsewhere, was attacked by the same species of smut. If they were they might throw some light on the question. It is conceivable that different varieties of wheat may vary in their relative susceptibility to the two species of Tilletia which cause bunt.

As to the control of bunt by seed treatment, the results reported are satisfactory in that they show practicability and efficiency, especially where properly carried out, except in the far west where soil infestation occurs. Data bearing on this phase gathered by the cereal disease survey men are summarized in Table 5.

It is to be noted that almost perfect control resulted very generally except in Idaho, Washington, and California, which latter is explainable by the fact that soil infestation occurs in those states.

In general, some form of the wet formaldehyde method, dilution 1 pint to 30 or 40 gallons, was most commonly used in the central and eastern states, while some form of the copper sulphate method usually proved most satisfactory in the far west where soil infestation occurs.

As to the extent of seed treatment of wheat, collaborators were requested to estimate the percentage of farmers in their states who disinfect seed wheat for the prevention of bunt. The following reports were received:

Virginia: "This varies greatly in different counties according to the activities of the county agents. About 10% treat for bunt. Bluestone is more generally used than formaldehyde." Fromme.

West Virginia: "There are a very fair number of farmers, possibly 10%, who treat wheat for bunt." Giddings.

Tennessee: "Five per cent." Essary.

South Carolina: "Thirty five per cent." Seal.

Louisiana: "Practically none." Edgerton.

Arkansas: "About 85% of the farmers treated their wheat for bunt in the fall of 1918, and the losses this year were greatly reduced. Fewer treated their grain in 1919, and an increase of bunt may be expected for next year since there were some bunt-infected fields in most localities. About half of the farmers use bluestone and half 1-40 formaldehyde." Elliott.

Ohio: "Thirty per cent." Selby.

Michigan: "Probably 10%." Coons and Bessey.

Minnesota: "Nineteen per cent of fields visited." Bisby.

Missouri: "I judge that one of 3-5 farmers treats wheat for bunt." Maneval.

Kansas: "Not over 1% of the farmers planting wheat treated for bunt." Melchers.

Colorado: "Approximately 20% of the farmers treat wheat for bunt." Leach.

Nevada: "Twenty-five per cent." Lantz.

Idaho: "Seed treatment for bunt almost universal. Copper sulphate common agent." Hungerford.

Washington: "Ninty-nine per cent." Heald and Dana.

California: "Ninty-five per cent or over." Smith.

A special questionnaire was sent to all collaborators asking for data on results with the so-called "dry" formaldehyde method on wheat. Replies were received as follows:

Virginia: "Considerable seed injury reported, due in all cases investigated to failure to follow directions. The most common cause of trouble came from holding grain too long before planting." Fromme.

Arkansas: "Dry formaldehyde failed to control bunt completely and reduced the germination to 25% on the test made by the Plant Pathology Department. The dry treated plat gave 2% bunt against 23% in the check plat." Elliott.

Ohio: "Unfavorable on wheat." Selby.

Michigan: "Satisfactory on wheat." Coons.

Kansas: "The dry formaldehyde method is not advisable for hard winter wheat, since in the preliminary experiments, it did not control the bunt and in all cases where the wheat was kept in storage for any length of time, serious injury resulted." Melchers.

Colorado: "The dry formaldehyde treatment (pint to pint) was ineffective in the control of bunt. Twenty-eight per cent of bunt was developed in the plats treated by the dry method while the standard sprinkling method (1-40) gave 100% control." Leach.

Idaho: "Dry formaldehyde method was used for wheat again this year in treating for bunt. The results were not satisfactory. Two lots of wheat were used which gave 50% and 52% respectively in the checks.

The dry method with no covering afterwards gave 28% and 30% respectively. The same covered five hours gave 10% and 13% respectively. The same covered twenty four hours gave 8% and 18% respectively. Copper sulphate, one pound to five gallons of water dipped for ten minutes gave only a trace in any case whether dipped in lime after or not, and the 1-40 formaldehyde dip method gave a smut-free crop in each case." Hungerford.

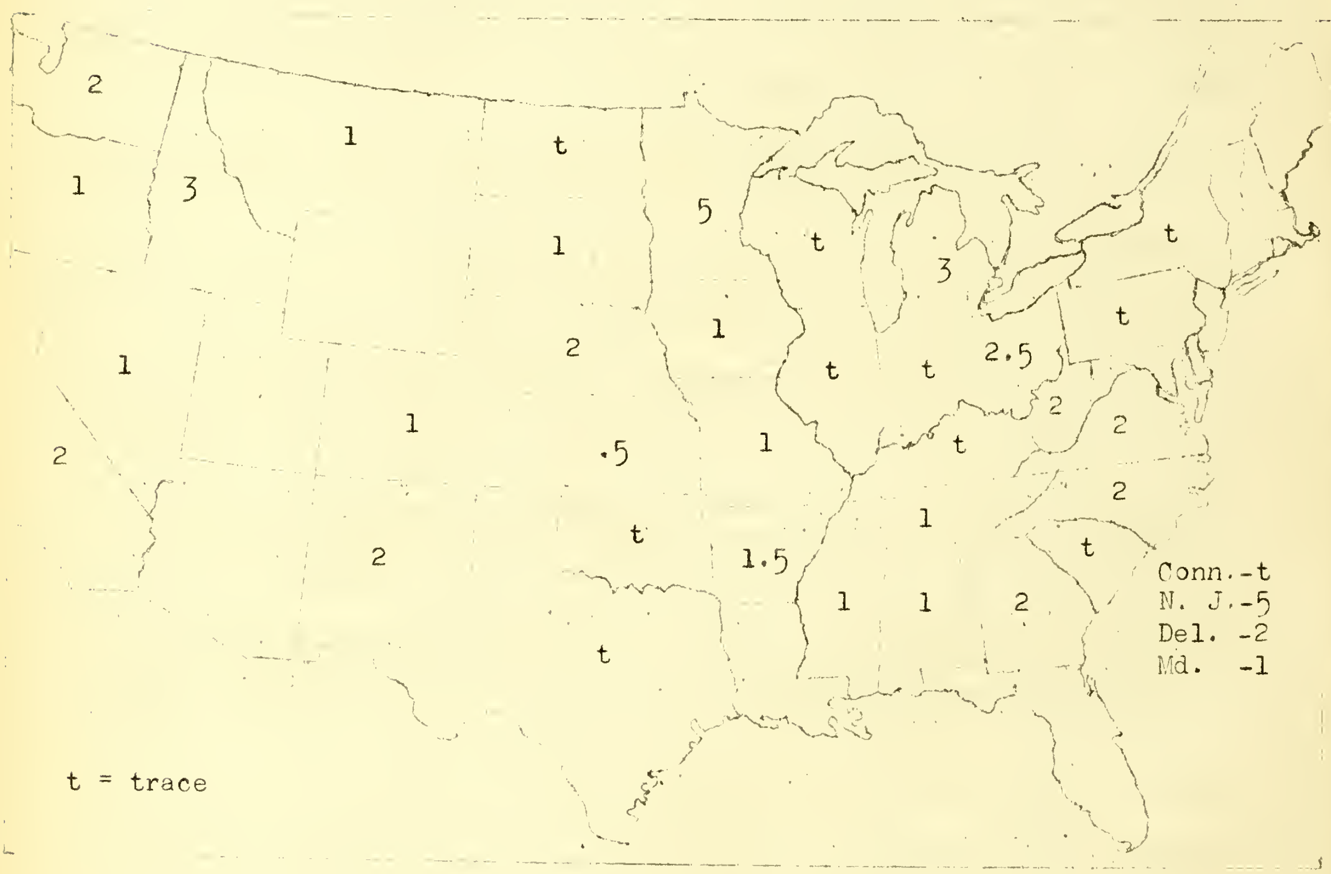


Fig. 3. Estimated percentage reduction in yield from bunt of wheat, 1919.

Loose smut caused by Ustilago tritici (Pers.) Rostr.

The occurrence of loose smut of wheat during 1919 was practically coextensive with the wheat crop and occasioned marked losses in a number of states. In other states the losses it caused were negligible. In general, the disease seems to have been somewhat more severe than in 1918.

On the accompanying map are indicated the occurrence and estimated percentages of reduction in yield in the states where losses were reported. It is to be noted that the highest average percentages of loss occurred in the South Atlantic states, especially West Virginia, Virginia, and North and South

Carolina. In Maryland, Georgia, Kansas, Oklahoma, Arkansas, Mississippi, Indiana, Ohio, and Pennsylvania the percentages of loss were considerable; namely; 2-3.5%. The estimated losses from loose smut in 1919 are summarized in bushels in Plant Disease Bulletin, Supplement 12, 1920.

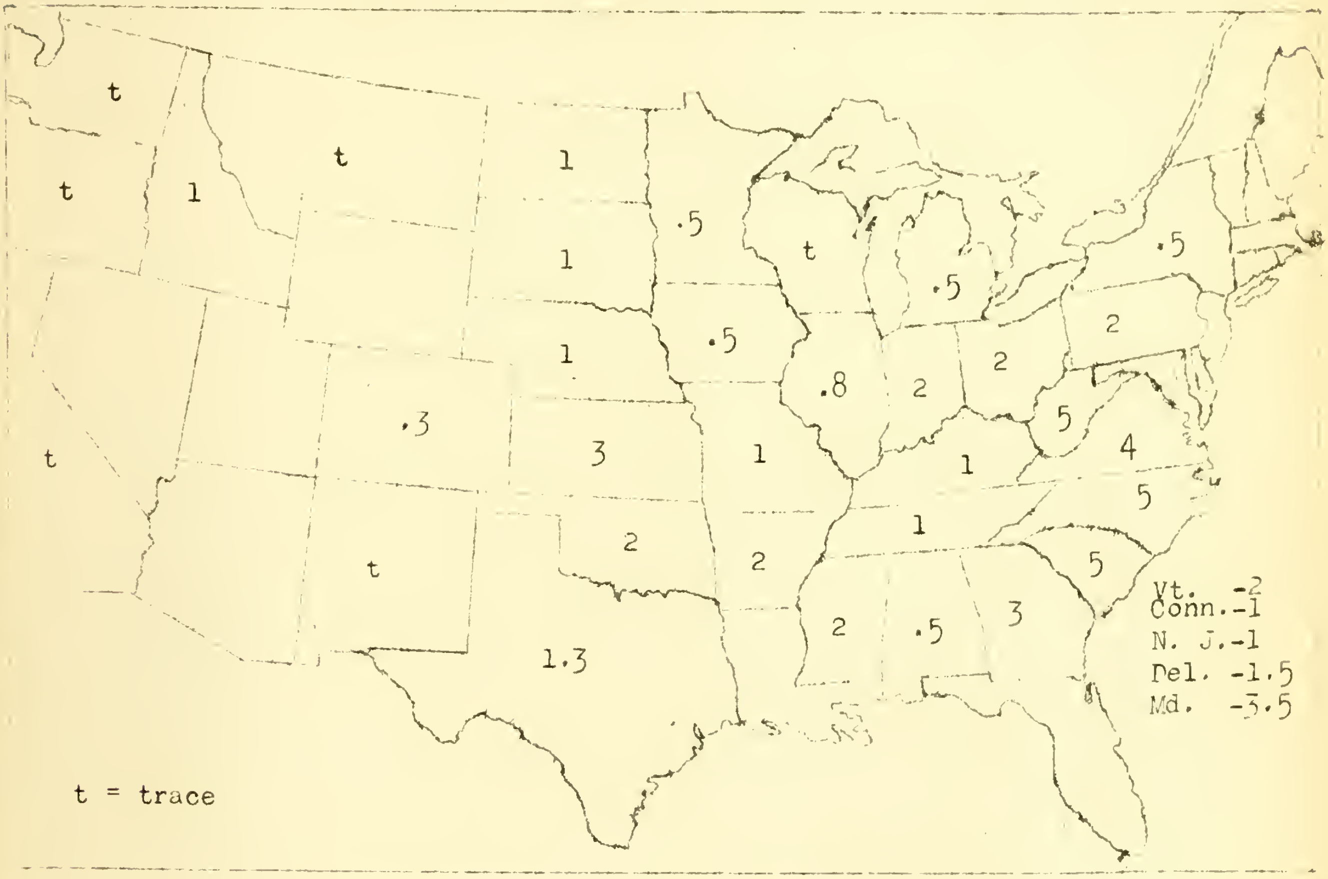


Fig. 4. Estimated percentage reduction in yield from loose smut of wheat, 1919.

In a number of states rather unusually high percentages of loose smut were noted in individual cases as follows: Ohio - 34; Indiana - 30; Maryland, Illinois, and Texas - each 20. The accompanying table and diagram represent the average percentages of loss for each state and the highest percentages as far as reported from any one field. It will be noted that with but few exceptions the states where the highest percentages were reported are not those with the highest average percentages of loss. This would seem to indicate that, from the standpoint of the individual farmer, this disease justifies being watched and fought in the above named states fully as aggressively, if not more so, than in the states where the average percentages of loss for the states are uniformly higher.

On the other hand, there is another factor to consider. Fromme has shown that in Virginia with uniformily infected seed the percentages of loose smut in the crop tends to vary inversely with the fertility of the soil. This may not be without significance in explaining the high average percentages of

Table 6. Losses from Loose Smut of Wheat.- 1919. Table and diagram showing:

(1) the average estimated percentage of loss in each state.
(2) the highest percentage of loss reported from any one field.

(1)	(2)		0 5 10 15 20 25 30 35%
		Maine	
		New Hampshire	
2.		Vermont	00
		Massachusetts	
		Rhode Island	
1.		Connecticut	0
.5	5	New York	o****
1.		New Jersey	0
2.	12	Pennsylvania	00************
1.5		Delaware	0o
3.5	20	Maryland	000o****************
4.	15	Virginia	0000***********
5.		West Virginia	00000
5.		North Carolina	00000
5.		South Carolina	00000
3.	4	Georgia	000*
		Florida	
2.	34	Ohio	00********************************
2.	30	Indiana	00****************************
1.	20	Illinois	0*******************
.5		Michigan	o
t	2	Wisconsin	t*
.5	10	Minnesota	o*********
.5	5	Iowa	o****
1.	18	Missouri	0*****************
1.		North Dakota	0
1.		South Dakota	0
1.	6	Nebraska	0*****
3.	15	Kansas	000************
1.	17	Kentucky	0****************
1.	8	Tennessee	0*******
.5	10	Alabama	o*********
2.		Mississippi	00
		Louisiana	
1.5	20	Texas	0o******************
2.	12	Oklahoma	00**********
2.	6	Arkansas	00****
t	3	Montana	t**
		Wyoming	
.5	4	Colorado	o***
t		New Mexico	t
		Arizona -	
		Utah	
		Nevada	
1.	12	Idaho	0***********
t	5	Washington	t****
t		Oregon	t
t	4	California	t***
			0 5 10 15 20 25 30 35%

Legend
0 = (1)
0+* = (2)

0 = average percentages; * = highest percentages; o - .5%; t - trace

the South Atlantic states. On this basis the occasionally high percentage in the newer states might be chargeable to unusually heavily infected seed, and possibly to other unknown factors.

No differences as to varietal susceptibility were noted.

As for control measures, the modified hot water method is reported efficient but it is practiced only to a very limited extent. The cereal disease survey men reported having seen wheat fields only in Maryland, Tennessee, and Indiana where the seed had been treated by the modified hot water method. In Indiana forty-five fields were thus noted, in Tennessee two, and Maryland one.

Reports from collaborators also indicated very limited use of the modified hot water method of seed treatment.

In West Virginia Giddings reported as follows: "So far as I know there was never any attempt to use the hot water treatment until this year. I believe that the treatments this year by six farmers, or rather by our department at six farms, were very successful."

In Ohio Selby estimated that 5% of farmers made use of this method.

In Arkansas Elliott reported as follows: "So far as I know the hot water treatment is not used by any of the farmers. The Plant Pathology Department freed the wheat varieties on the Experiment Station from loose smut by this method."

In Idaho Hungerford stated that "Very few use hot water treatment. We are planning a campaign for hot water treatment for seed stock next year."

In Indiana this method, together with the use of seed plots, has been rather extensively tested by the Experiment Station in cooperation with the Office of Cereal Investigations and found practicable. Special equipment for central treating stations has been devised and put into use with satisfactory results.

On the whole it seems clear that the modified hot water method, carefully done, together with the use of seed plots, offers a practicable means of controlling this disease.

Flag smut caused by Urocystis tritici Koern.

Flag smut of wheat, previously known only from India, Eastern Asia, and Australia, was found for the first time in the United States, in Madison County, Illinois, May 5, 1919, as related in U. S. D. A. Farmers' Bulletin 1063 and Plant Disease Bulletin 3:43, 1919. While search was made for this disease in all of the principal wheat growing states by collaborators, cereal disease survey men, and others, it was not found at any other point except in Madison County, Illinois. Altogether the disease was found on twenty farms in the western half of Madison County. The accompanying table gives the different wheat varieties found attacked by flag smut and the number of fields of each.

In each of these fields comparatively low percentages of infection were found; namely, from a trace up to about 2%. As high as 5% was found in limited areas of one field.

No evidence has as yet been adduced as to when or how the disease was introduced into this county. Attempts were made with this in view but no definite information was forthcoming except that in a few cases farmers remember distinctly of having seen the flag smut of wheat in their fields the preceding year. Indications are that the disease has been in Madison County, Illinois for a few years at least.

Table 7. Varieties of wheat infected with flag smut in Madison County, Illinois, in 1919.

Name of variety.	Number of fields infested.
Golden Straw	2
Jones Fife	3
Red Cross (Salzer's Prize Taker)	11
Red May	8
Red Wave	2

With a view of checking the disease the grain from affected fields was given a double strength formaldehyde "dry" treatment after being threshed, and not used for seed purposes. This work was carried out by the Illinois State authorities in cooperation with the Office of Cereal Investigations.

The so-called take-all or foot rot (cause not definitely determined).

A disease of wheat tentatively called take-all, also called foot-rot, was discovered in Illinois and Indiana as related in Plant Disease Bulletin 3:43-46, 1919, and in U. S. Department of Agriculture Farmers' Bulletin 1063. What is possibly the same disease was also reported by Leach from Colorado in a field near Denver, June 2. Somewhat similar troubles, although apparently somewhat different, have been found in Washington and Virginia. Search in other wheat producing states for similar troubles was made by collaborators and cereal disease survey men, but with negative results.

While the losses from the disease were heavy in individual cases, on the whole they were rather slight. In most of the infested fields the affected areas were comparatively small, while in others as high as from 50 to 75% of the acreage was affected. A few very bad fields were plowed up and planted to other crops and more would have been had it not been for the very wet spring season, especially in southern Illinois. The worst affected fields that were left recovered considerably and certain of them yielded about 9 bushels per acre. However, the normal yields should have been 30 to 40 bushels per acre.

In Illinois and Indiana the disease occurred almost entirely in one variety of wheat, namely; that known as Red Cross. In southern Illinois this variety goes most commonly under the name of Salzer's Prize Taker. One field of Fultz wheat, one of Red Chaff wheat, and one of White Clawson were found affected.

Attempts were made to learn how long the disease had occurred in these infested sections and from what source or sources it had been introduced, but very little definite information has as yet been forthcoming. In a few cases it was definitely reported by farmers that they had seen the disease the preceding year.

On the whole, whatever the causes of the disease may prove to be, it seems fairly clear that the combination of conditions brought about by the unusually mild preceding winter probably favored the development of the trouble.

On account of the threatened severity of the disease, precautionary measures were taken in Illinois and Indiana with a view of checking its spread. The grain from infested fields was given a double strength formaldehyde "dry" treatment after being thresned, and not used for seed purposes. This work was carried out by state authorities in cooperation with the Office of Cereal Investigations. Precautions were also taken to prevent the straw from infested fields from becoming a source of further infection. It was either burned or used in paper mills. Threshing machines were also disinfected after threshing the grain from infested fields. The infested fields were to be used for other crops than wheat, barley, and rye for a term of years until it should be found by investigations to be safe to replant to wheat. Later, by special ruling, the planting of oats on infested land was allowed with the understanding that if the disease should develop in the crop the grain would be disinfected and the straw burned or otherwise handled so as to preclude the possibility of spreading the disease.

Stem rust caused by Puccinia graminis Pers.

Stem rust of wheat may be said to have been epidemic during 1919. Its attacks were very severe in a number of important wheat states, especially in the Upper Mississippi Valley. The disease started rather early in this region and, favored by the weather, spread rapidly, involving the northern portion of the winter wheat states and the entire spring wheat area in an outbreak such as had not been experienced since the epidemic of 1916. The accompanying map shows the distribution of losses by states and estimated percentages of reduction in yield for stem rust in 1919. The complete data on losses are given in tabular form in Plant Disease Bulletin, Supplement 12, 1920.

The following report from North Dakota by Professor Bolley is of especial interest.

> "Stem rust (Puccinia graminis) was very destructive throughout the eastern portion of the state from the Red River Valley to the Missouri and came in the form of general epidemic infection. It could not be looked upon, as in some years, as due to a local infection but swept over the border uniformily along the entire eastern and southern front. The first date of infection on bushes of barberry was located at Walcott, Richland County, April 28th. The first infection on wheat itself in the red stage is recorded for the region of Fargo on date of June 23rd and quite generally distributed June 25th.
>
> "The destruction wrought by rust this year was even more severe and extended than in the great rust epidemic year of 1916. Associated as it was with peculiar weather conditions giving a good infection period just at the right time, followed by intense drought and hot winds just after the out-break of the rust, a reduction of yield which is enormous was brought about. The wheat rust and scab alone under these conditions resulted in from probably 40 to 60% of the possible normal crop. In this connection it must be remembered that the entire damage done cannot be assigned to any one cause. Rust should not be given credit for the entire destruction for we have long since learned that a heavy infection of rust and a heavy breaking out of stem rust can occur without shrivelling, if weather

conditions are correct and no other imperfect fungi are attacking. However, scab and other imperfect fungi develop profusely under essentially the same conditions which facilitate the development of rust. When the stem is mutilated or injured by the rust pustules, fusarial fungi and other stem parasitic and saprophytic forms readily destroy the straw structure."

The greatest losses occurred in the barberry eradication area. This is at least partly chargeable to the fact that the barberries were not all out. Severe attacks of the rust also occurred in West Virginia in many sections of which state numerous barberries were found along fences and roadsides growing wild. This was especially true in Monroe County.

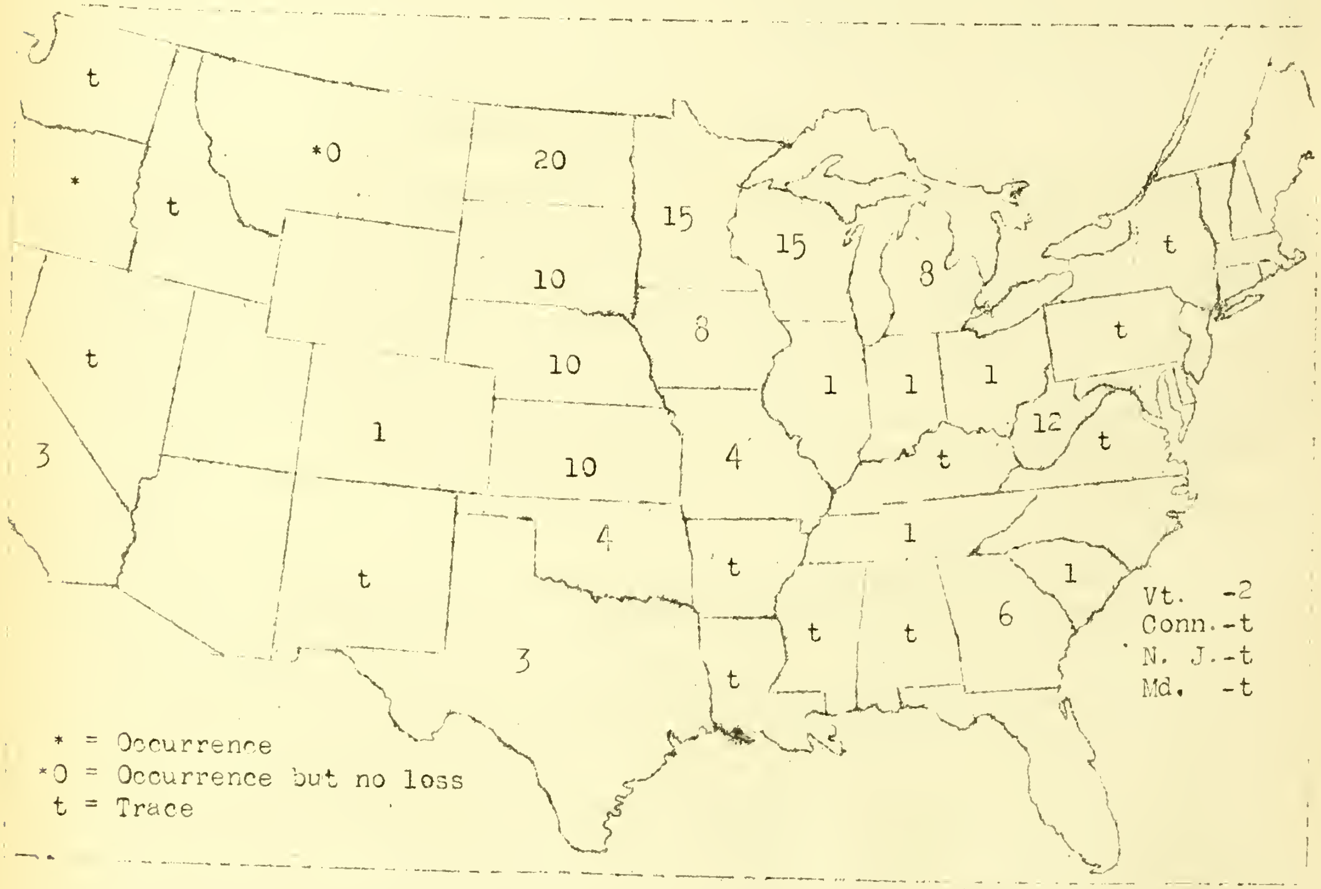


Fig. 5. Estimated percentage reduction in yield from stem rust of wheat, 1919.

While the barberry eradication campaign was pressed vigorously in most states of the barberry eradication area, numerous infected barberries, both cultivated and escaped, were found widely scattered in a number of states. As in the preceding year, a number of cases were noted, especially in the northern states, where infected barberries were clearly the centers of infection from which the rust had started in the spring. In a limited number of cases early infections, especially on certain grasses, and later on wheat or other grains, were noted at considerable distances from infected barberries. This seems to indicate that, under the conditions of the unusually mild preceding winter there may have been at least a certain amount of overwintering on grasses even as far north as Wisconsin. This, especially in the northern states, is in rather sharp contrast with indications the preceding season which was preceded by a rather severe winter. At that time, there was scarcely any indication of overwintering on grasses, especially in the north. The Office of Cereal Investigations continued their special study of this phase of the problem in 1919 and the detailed results will be summarized by that Office and published later.

The barberry clearly seems to be the most important source of early spring infections, at least in the spring wheat states. Especially is it a factor in starting the rust early and it is these early infections that may play a very important part in initiating epidemics.

As to rust resistant varieties of wheat, Kanred selections are reported as showing resistance in Kansas and Oklahoma, and Acme and North Dakota D 5 are similarly reported from North and South Dakota, and Mindum, a durum wheat, is practically immune in Minnesota. Regarding the resistance of this variety, E. C. Stakman reported:

> "Mr. P. J. Olson, who was formerly in the Agronomy Department of the University and is now operating a farm at Grafton, Minnesota, said that his Marquis yielded less than half a crop and was very severely rusted. He had a few acres of Mindum growing along side the Marquis and it was scarcely possible to find a trace in the field. The yield was between 20 and 25 bushels per acre. It had escaped rust damage entirely."

A special questionnaire was sent to collaborators asking about progress made in barberry eradication and results. Replies were received as follows:

Virginia: "None undertaken." Fromme.

West Virginia: "There has been practically no effort to eradicate the barberry." Giddings.

Tennessee: "The common barberry is not native in Tennessee. No effort has been made to eradicate the few hedges in the state. There is no evidence that the barberry is a factor in the wheat stem rust situation in this part of the country." Essary.

Arkansas: "No barberries in this state that I know of." Elliott.

Ohio: "Work not done through this office during 1919, but results reported by Prof. W. G. Stover quite satisfactory. Ruling entered December 20, through formal notice of hearing by Secretary Board of Agriculture, requiring removal of all forms of *Berberis vulgaris* and varieties, from nursery plantations in Ohio." Selby.

Michigan: "The following statistics from the Barberry Campaign reveal an almost unbelievable number of barberries which have been found by federal field agents working in cooperation with the college. It is noteworthy that at least fifteen areas where the barberries had escaped to woods and waste lands have been found.

The barberry menace has been attacked not a bit too soon. The figures are as follows:

New Barberry Location for 1919 - (Up to Sept. 1.)

No. of counties surveyed	51
No. of locations in towns and cities	656
No. of locations in country about residences	581
No. of locations in fields, woods, and roadsides	82
Total locations found	1319
In terms of bushes found:	
No. of bushes found in towns and cities	4301
Of these, the following were infected with black stem rust of grains	3174
No. of bushes found in country about residences	7540
Of these, the following were infected with black stem rust of grains	5876
No. of bushes found wild	3298
Total bushes found	15139"

Minnesota: "55,441 bushes of common barberry were located in 70 counties; of these 35,788 bushes carried rust infections. 13,918 bushes were located in towns; 41,523 bushes were located on 326 farms in 53 counties. Of these 36,685 bushes were growing wild in 25 counties. 50,541 bushes have been completely removed - 4,900 remain to be destroyed. These will be removed before the infection period next year." Bisby.

Missouri: "No eradication work on barberry has been done in this state. The barberry seems to be rather unimportant as far as stem rust is concerned." Maneval.

Kansas: "Kansas has not entered the barberry eradication campaign." Melchers.

Colorado: "The final figures from the campaign against the common barberry in Colorado during the year 1919 show that there were approximately 17,677 of these bushes in the state. The scouts inspected the properties of nearly every town in the state. A large percentage of the rural districts were also scouted by means of automobiles. The 17,677 bushes found were located on 1,502 properties. Each of these properties were revisited to make sure that the bushes were removed. The educational phase of the program was pushed with especial emphasis. The workers did all that they could to inform the public of this pest and how it worked. Talks were given in nearly every grade in every school in the state, in town halls and in public gatherings of all kinds. Newspaper articles were published in all papers, ranging from the dailies of the cities to the tri-monthly edition of the rural districts. The moving picture houses donated their services in showing explanatory slides before their patrons. The animated cartoon supplied by the United States of Agriculture was used to much advantage. In fact, every method practicable was used in disseminating information. The campaign will be continued during the winter and again next spring. The winter program will consist of continued educational work, specimens of infected barberry, infected wheat and Japanese barberry, with explanatory material, are to be sent to every school and school teacher in the state. These specimens are to be prepared in such a form that they may be hung in a conspicuous place. As a whole, the barberry campaign has been very successful." Leach.

Idaho: "Accurate information not available." Hungerford.

Washington: "Barberry eradication not recommended for Washington." Heald.

California: "The barberry is not a factor in rust eradication in the state." Smith.

This rust was reported also on spelt in Minnesota.

Leaf rust caused by *Puccinia triticina* Erik.

During the past year the leaf rust of wheat was unusually severe. It varied in destructiveness from nothing to total loss of the crop, with various gradations between. In individual cases, especially in Georgia and Arkansas, certain fields of winter wheat were so severely attacked by leaf rust that they were abandoned in the spring of 1919, plowed up and planted to other crops. Never before in this country have so severe injuries from this disease been recorded. The severity of the attacks were apparently accentuated, especially in the southeastern states, by the fact that tht winter was very mild. The rust was able to obtain a good start in the fall and propagated late into the winter and again in early spring. In this way it caused severe injury when the wheat was unable to keep pace with it or keep sufficiently ahead. Hence the losses caused by leaf rust in the southern states were considerable. Farther north the wheat was, as usual, better able to withstand the attacks of leaf rust, but on the whole no doubt suffered somewhat from the rather heavy attacks. In Virginia it was especially severe east of the Blue Ridge Mountains, where it caused marked losses. In Pennsylvania infection was especially severe in the southeastern part of the state. The rust attacks were less severe in the more mountainous sections. In the far northwest and western states no appreciable injury was reported except in a few cases, especially in Montana where rather severe attacks were noted locally in certain irrigated sections.

The accompanying map shows the estimated percentages of reduction in yield in the various states caused by leaf rust in 1919. These data together with the corresponding losses in bushels computed from estimated productions are given in tabular form in Plant Disease Bulletin, Supplement 12, 1920.

Certain variations in varietal susceptibility were noted both by the cereal disease survey scouts and by certain collaborators. In general practically all wheat varieties are highly susceptible. It was, however, noted both in Kansas and Tennessee that the Kanred selections, especially P 1066 and P1068, showed marked resistance. In North Dakota it was noted that certain durum wheat selections, especially North Dakota D 1 and D 5, showed resistance to leaf rust. It was also noted in the Alabama Experiment Station wheat variety test plots that a durum wheat showed resistance to leaf rust. In Arkansas it was noted that the earlier varieties escaped to some extent. This rust was reported also on spelt from Indiana and Minnesota, and on rivet, emmer, and einkorn from Indiana.

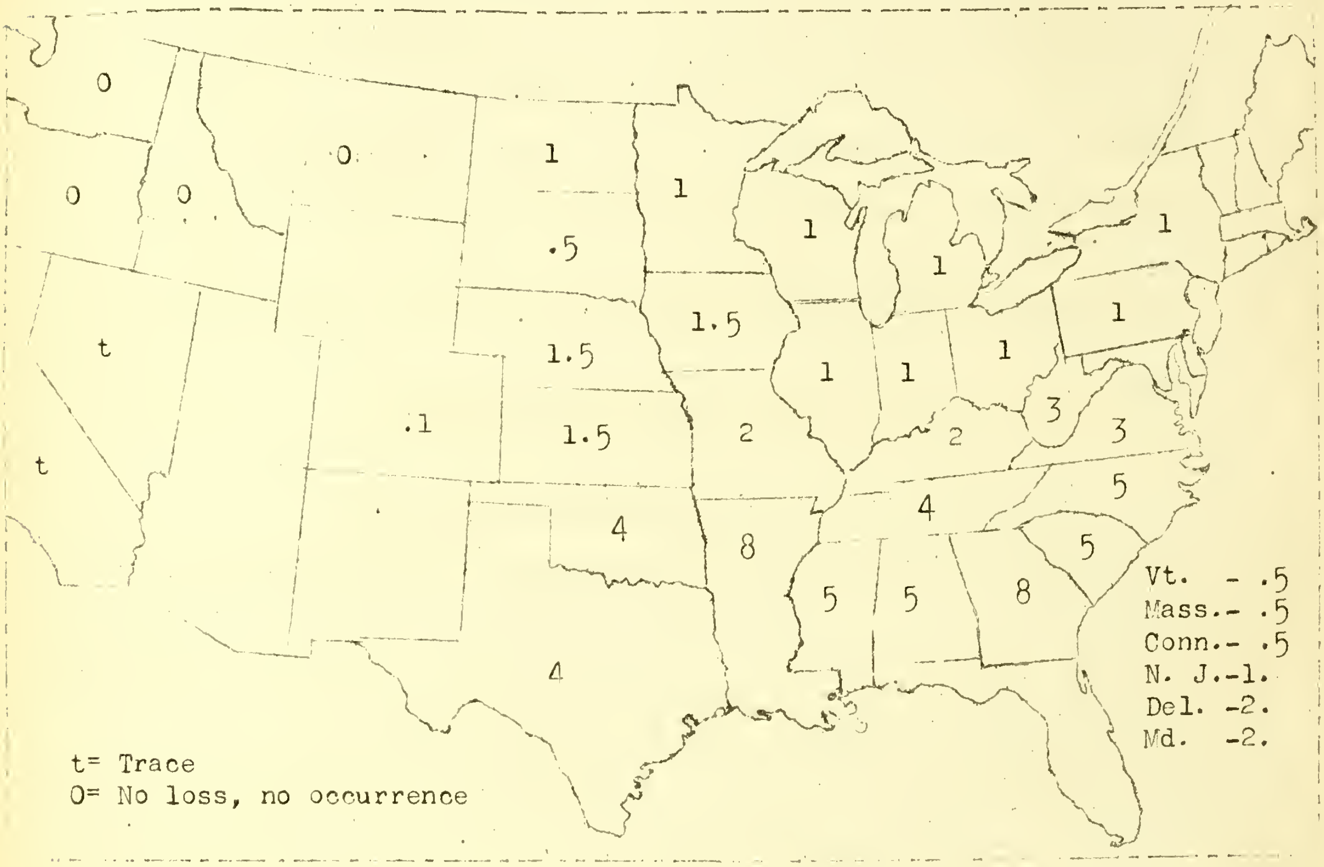


Fig. 6. Estimated percentage reduction in yield from leaf rust of wheat, 1919.

H. S. Jackson, who is making a special study of this rust at the Indiana Agricultural Experiment Station in cooperation with the Office of Cereal Investigations, United States Department of Agriculture, has kindly furnished the following summary of the season's work bearing on varietal susceptibility.

> "We grew ten varieties of durum wheat. All showed marked resistance to the leaf rust. One variety of Polish wheat showed but slight infection. Six varieties of emmer which were grown here showed considerable resistance. A variety of einkorn only slight flecking. Four varieties of rivet and spelt showed a somewhat higher degree of susceptibility than the durums but were not as susceptible as most of the common wheats. Fourteen varieties of club wheats also showed heavy infection. Of about two hundred varieties, selections and hybrids of the common wheats, only about fifteen selections of four hybrids showed any resistance. All those showing any degree of resistance were of the Crimean group.

"In general then, the durums, emmers, Polish, and einkorns showed considerable resistance. The rivets and spelts were intermediate and except for a few varieties the common wheats showed considerable susceptibility. The club wheats were all very susceptible."

Stripe rust caused by Puccinia glumarum (Schm.) E. & H.

Stripe rust was reported on wheat in 1919 from Idaho, California, Oregon, and Washington.

In Idaho C. W. Hungerford reported the rust as not common, but reported its occurrence on wheat from the following counties: Bonner, Latah, Nez Perce, Lewis, Idaho, Washington, Fremont, Jefferson, and Madison.

In Oregon the following report from C. E. Owens summarizes the situation including the occurrence of the rust on wild grasses: "Occurs on susceptible varieties of wheat such as Little Club, Jones Winter Fife, and slightly on Turkey Red. Absence of rust on wheat growing in close proximity to infested grasses in some localities due to fact that wheat happens to be resistant variety. Very severe outbreak on susceptible varieties of wheat on Experiment Station grounds at Moro, Oregon.

"Stripe rust is abundant on grasses, especially Elymus, throughout territory west of Cascades, and in Sherman County on Agropyron. Has been reported as far east as Union County."

In Washington Heald and Dana reported the rust as occurring in slight amounts in Whitman and Spokane Counties.

Scab (blight) caused by Gibberella saubinettii (Mont.) Sacc.

Wheat scab (blight) was unusually severe in 1919, especially on the wheat heads and caused enormous losses in the Upper Mississippi Valley and eastward. The seedling blight was also reported from Minnesota, Wisconsin, Illinois, and Indiana. The seedling blight was particularly severe in Minnesota where it is reported as follows: "The seedling blight disease was very prevalent in the Red River Valley and some other parts of the state in the latter part of May and early June. The wheat scab organism was isolated from many of the diseased seedlings, particularly the macaroni wheats, though Helminthosporium was often present also. The disease often appeared in spots causing a complete failure in the diseased area. Many fields were plowed and planted to flax." (Division of Plant Pathology.)

By far the greatest losses from the head blight occurred in Iowa, Illinois, and Indiana. Very heavy losses occurred also in Ohio, West Virginia, Kentucky, Tennessee, Wisconsin, Missouri, Minnesota, North and South Dakota. In a number of other states the losses while great, were, in general, considerably less. In other states there was no loss or it was negligible. From some states no reports were received.

The unusual severity of wheat scab was emphasized by collaborators in a number of states as follows:

Iowa: "Very common throughout the state. Most destructive disease of wheat in state." A. L. Bakke.

"Scab in Marquis has developed to a serious degree." I. E. Melhus. "Much damage reported, especially in the southeastern section, due to scab." I. E. Melhus.

Illinois: (July 2) "Particularly serious this season; in many fields will cut the yield more than 50%. The disease has been reported very generally all over the state. Some county agents have estimated that from one-half to three-quarters of the crop is infected. It has developed very rapidly during the past week or ten days and the loss will be much greater than was anticipated a week ago." W. L. Burlison and G. H. Dungan.

Indiana: "Wheat scab is the most serious wheat disease in Indiana and has been reported from all parts of the state. Infection varied from 0 to 100% and the yield was greatly reduced in many cases. This disease is illiciting inquiries from a large number of growers." M. W. Gardner.

Ohio: "Generally severe, especially in western and northern Ohio and where wheat followed corn. Maximum per cent of head attack 80%. Low percentages in southeast. Estimated maximum loss in yield scarcely exceeds 33%." A. D. Selby.

Tennessee: "Heaviest damage known. Serious damage. Loss estimated 10 to 90%." S. H. Essary.

West Virginia: (July 1) "This, I believe, is the most serious disease of wheat in West Virginia. Last year it was very prevalent and the wheat was refused at some mills on account of the scab infected grain. This year it is quite generally reported and is likely to be as destructive as it was last year." N. J. Giddings.

Minnesota: "One of the worst diseases of wheat this year was, by all odds, scab. It is infinitely worse than it has been since 1916, and especially in the southern third of the state. It is remarkable, that it became less severe in traveling north through the wheat region." (August) E. C. Stakman.

North Dakota: "Scab caused great damage in Marquis, Fife, Blue Stem, and most species of durum throughout the state. It was destructive at all stages, particularly on old crop lands under constant cultivation and often on new lands where scabby seed was used." H. L. Bolley.

Numerous cases were observed and many others reported, particularly in Illinois, where scab (blight) was so severe on Marquis wheat that large fields were left unharvested. Others were harvested, at least in part, and when threshed yielded as low as five and six bushels to the acre where thirty-five or forty bushels per acre were expected before the disease developed.

Particularly in southeastern South Dakota, southern Minnesota, southern Wisconsin, Iowa, Illinois, Indiana, Kentucky, and Tennessee wheat scab (blight) was, by all odds, the most important factor in the shrinkage of yields and lowering of quality of wheat in 1919. In these states alone there was, according to estimates made by the Bureau of Crop Estimates, a total shrinkage of 88,509,000 bushels of all wheat from the June 1 forecast. The following table shows this more in detail and just where the greatest losses occurred.

Table 8. Forecast and production of wheat in certain states in 1919.

States	Forecast June 1 from condition		Production Recorded December		Shrinkage from forecast.					
	Winter (000 omitted)	Spring (000 omitted)	Winter (000 omitted)	Spring (000 omitted)	Winter (000 omitted)		Spring (000 omitted)		Total (000 omitted)	
	bushels	bushels	bushels	bushels	%	bushels	%	bushels	%	bushels
South Dakota	1,957	48,684	975	29,200	50	982	40	19,484	40	20,466
Minnesota	1,486	61,451	975	36,735	34	511	40	24,716	40	25,227
Wisconsin	2,326	8,691	1,490	5,865	36	836	33	2,826	33	3,662
Iowa	18,119	11,053	16,530	7,145	9	1,589	35	3,908	19	5,497
Illinois	67,985	15,675	57,800	7,875	15	10,185	50	7,800	21	17,985
Indiana	56,656	822	45,792	228	19	10,864	72	594	20	11,458
Kentucky	14,707		12,029		18	2,678			18	2,678
Tennessee	8,826		7,290		17	1,536			17	1,536
Total	172,062	146,376	142,881	87,048		29,181		59,328		88,509
Total all wheat (000 included)	318,438,000 bu.		229,929,000 bu.		88,509,000 bu.					

While in this group of states stem rust was responsible for considerable of the shrinkage from the June 1 forecast in South Dakota, Minnesota, and Wisconsin, scab was the one big factor in the other states named; that is, in Iowa, Illinois, Indiana, Kentucky, and Tennessee. The heavy losses from scab in South Dakota, Minnesota, and Wisconsin were largely confined to the southern parts of those states.

Special studies were made of various phases of the wheat scab problem by the Office of Cereal Investigations. These investigations were conducted especially in Wisconsin, Minnesota, Nebraska, Iowa, Illinois, Indiana, Ohio, Kentucky, and Tennessee. In connection with this work in each of thest states carefully made estimates as to severity of scab were made. The data thus obtained supplement those obtained by the general cereal disease survey men and collaborators. On the basis of all these data and information on the varying crop conditions, careful estimates of percentages of reduction in yield in the various states due to scab have been arrived at as indicated on the accompanying map. The estimated losses summarized in bushels are given in Plant Disease Bulletin, Supplement 12, 1920.

In connection with the different surveys, the Office of Cereal Investigations made a special study of the different species of Fusarium and Gibberella associated with wheat scab in the different states in 1919. The following is a brief summary of the results: "A careful study of over one thousand specimens collected in fifteen states showed _Gibberella saubinettii_ (Mont.) Sacc. to be the chief causal organism. Less than 1% of the specimens yielded _Fusarium culmorum_ (W. Sm.) Sacc., _F. avenaceum_ (Fr.) Sacc., and other Fusarium species."

From an analysis of the data obtained from the various sources it is evident that a number of inter-related factors were concerned in bringing on this wheat scab epidemic in 1919, such as (1) the abundant presence of the parasite in close proximity to the wheat, (2) favorably moist and warm weather conditions after wheat had headed, and (3) the presence of especially susceptible spring wheat in considerable abundance farther south than usual.

The extensive field observations showed that the parasite (_G. saubinettii_) was present in sporulating condition in and near wheat fields on a number of organic substrata, particularly old infested crop refuse on the surface of the soil such as corn stalks, old straw, and stubble of various grains and grasses.

In a number of cases in various states it was noticed that wheat scab was more severe where corn had been the preceding crop than otherwise. In other cases it was reported that equally as much scab occurred when the preceding crop had been wheat. In still other cases, observed especially later in the season, indications seemed to be that the air was so filled with spores of the parasitie that very heavy scab infections resulted regardless of the preceding crop. In some cases also scab infections were found heaviest near the edges of fields and near old straw stacks. Such infections seemed to be traceable to the abundance of the parasite on grass straw and stubble in the fence rows, and on the old straw at the bases of the straw stacks.

As bearing on the relative amounts of wheat scab where corn had been the preceding crop and not, a special questionnaire was sent to collaborators asking for "evidence showing relation between corn root and ear rots and wheat scab." While most collaborators reported no data, others reported as follows:

Pennsylvania: "In fields which followed corn the infection is about 10% on the average, and where corn was not the previous crop the infection is about 3 to 4%." C. R. Orton.

Virginia: "Worse following corn. The following data was obtained in Pulaski County by A. B. Massey on June 20. All percentages are based on counts of heads:

Farm No. 1. 20 acre field all seeded at same time with same seed, but parts had different treatment.

North end. No corn 1918, nor manure... .... 10% scab
Middle, No corn 1918, manure mixed with corn
stalks applied.................................. 20-40% "
South end. Corn 1918................................ 50% "
Farm No. 2.
Field A. 11 acres, 1917 grass, 1918 corn, 1919 wheat 50% scab
Field B. 7 acres, 1917 grass, 1918 wheat, 1919 wheat 2% " "
F. D. Fromme.

Georgia: "More noticeable when wheat follows corn." Berry.

Tennessee: "Evidence showing relation of corn root rot and wheat scab is very strong. Wherever the two crops follow each other, the diseases are always severe. We have little doubt of the relation." Essary.

Ohio: "Did not collect special memoranda. Found many cases of evidence of larger amounts of scab on wheat about areas of upturned corn roots." Selby.

Missouri: "There is some evidence that scab of wheat is worse where wheat follows corn than in other rotation." Maneval.

Minnesota: "The following are the results obtained this year on the effect of rotation on the percentage of scab:

Preceding crop	No. fields visited	Average percentage of disease	Yield in bushels.
Corn	193	23.53	5.62
Wheat	95	7.42	11.23
Oats	67	10.81	10.03
Barley	20	11.15	10.75

Kansas: "We have no evidence to show any relation between corn root rot and wheat scab. Corn root rot is present in this state this year, a small amount of scab was found in some localities. Most generally scab is not present in Kansas." Melchers.

As to the relative importance of the different kinds of old crop refuse on the surface of the soil, old corn stalks seem to be the most important as a substratum for the parasite, this no doubt because the fungus is able to grow in greater abundance on them because of their large size and general suitability when climatic conditions are favorable. Old straw and stubbles of wheat, oats, and barley, when not properly covered, also were important substrata for the parasite, as were straw and stubble of wild grasses in nearby fence rows and at edges of fields. There is no evidence at hand to show that the refuse from dicotyledonous crops or weeds furnished substrata for the parasite.

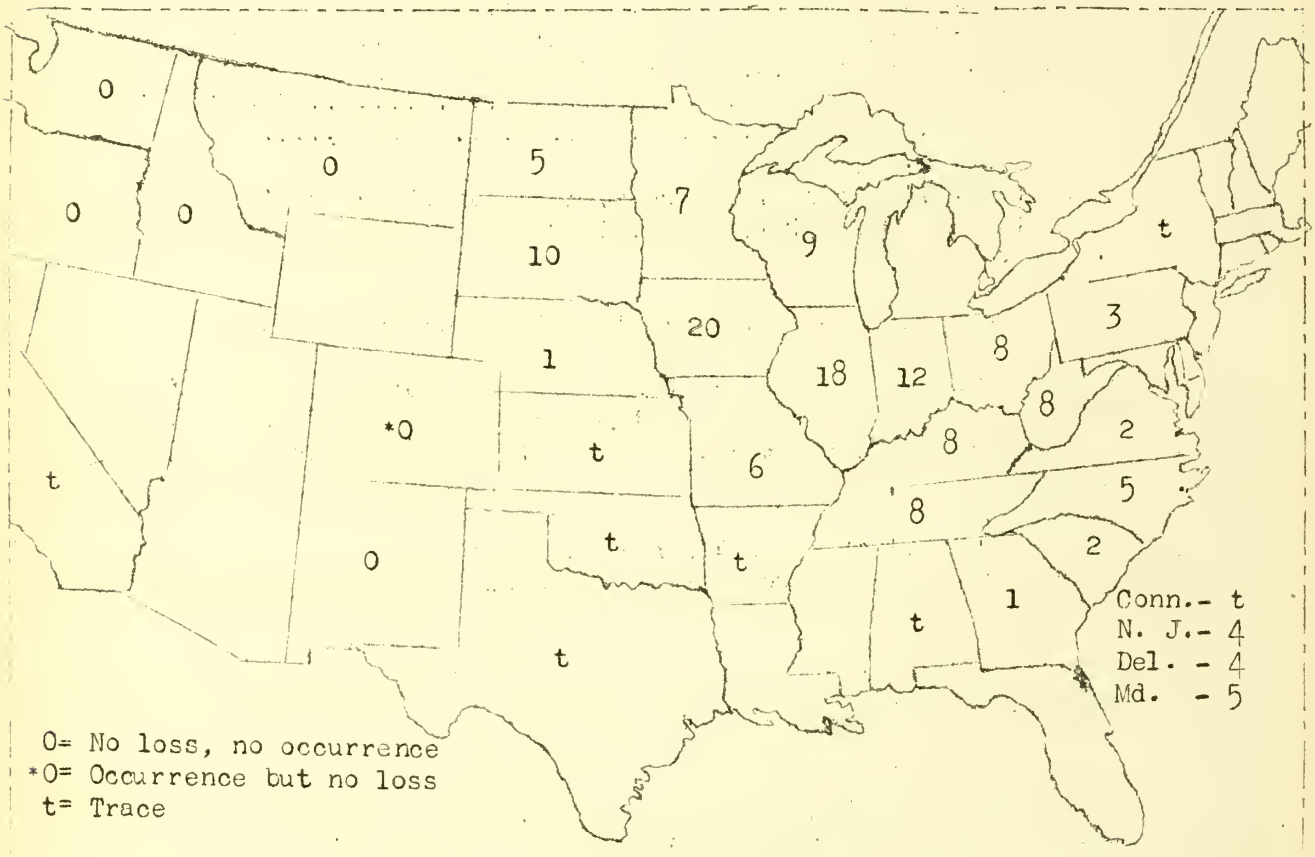


Fig. 7. Estimated percentage reduction in yield from scab of wheat, 1919.

Hence the abundant presence of the wheat scab organisms (G. saubinettii and Fusarium spp.) in sporulating condition on various substrata, in close proximity to the wheat following the blossoming period together with moist, warm weather at that time, favorable for spore dissemination and infection seem to have been the chief factors in bringing on the wheat scab epidemic in 1919. This disease was reported also on spelt from Minnesota.

As to relative susceptibility of varieties, definite data are very meagre. The following reports bearing on this were received:

South Dakota: "Marquis susceptible; Preston and Blue Stem only slightly better. Kubanka and Acme were resistant but "dodged" some of the scab due to different heading time." Manley Champlin.
"Usually durum wheats scab worse than Marquis. This year the reverse was true." Champlin.

Minnesota: "Marquis is most susceptible, though considerable is reported on Velvet Chaff and Blue Stem. Neighboring fields of Marquis and Velvet Chaff showed 100% and 15% infections respectively. Many of the varieties on University Farm are found susceptible." Section of Plant Pathology.

West Virginia: "Bearded varieties affected most severely." Giddings.

Maryland: "No particular variety was noticed as especially susceptible or resistant." Temple.

No successful control measures are reported.
This disease was reported also on spelt from Minnesota.

Nematode disease caused by Tylenchus tritici (Stein) Bast.

Special efforts were made to determine the geographic occurrence of the nematode disease of wheat in 1919. In addition to data gathered by the cereal disease survey men and collaborators, a special nematode disease survey was made in cooperation with the state authorities of Georgia, Maryland, Virginia, and West Virginia. Practically all inspections were made on the threshed wheat, hence the percentages given indicate proportions of nematode galls in grain.

In Georgia 35 communities in 19 counties in the northern part of the state were visited. Fortunately the disease was found only in the one county, Jackson County, where it was known to have occurred the preceding year. A special farm-to-farm survey was made in the infested portion of Jackson County and only 14 farms were found where the nematode disease could be located. On one of these farms a 50% infection was found. On the other infested farms the percentages of infection were comparatively low.

In Maryland 71 towns in 15 counties, covering the principal wheat growing sections, were visited without finding even a trace of nematode disease infection in wheat. Both Allegany and Montgomery Counties, where the disease was found the preceding year, were visited but with negative results. Of course this does not necessarily mean that the disease was absent. It simply means that the disease, if present, is not severe. The grain from a few infested farms might very easily not have been going through the elevators and mills when inspections were made in 1919.

In Virginia 357 towns in 72 counties were visited by cereal disease survey men and collaborators. The men visited mills, elevators, and farms. The nematode disease was found in 43 counties. In 29 counties either the disease was not found or was found in wheat brought in from some other county. The following table summarizes the data at hand by counties. In this table the following terms are used in general to represent conditions as follows:

Local = 1-20% presence; Scattered = 20-40% presence; Rather general = 40-60% presence; General = 60-80% presence; Very general = 80-100% presence. Very slight = Trace; Slight = About 1%; Rather severe = About 2%; Severe = About 3-4%; Very severe = 5% and above.

Table 9. Summary of data on the occurrence of the nematode disease of wheat in Virginia.

Counties	Infection			
	Severity in 1919			Number of records in previous years.
	General condition	Range	Number positive cases	
Albemarle	Very general, rather severe	Trace-30%	84	21
Alexandria	No data	No data		1
Alleghany	Local, very slight	Trace	1	0
Amelia	Local, very slight	Trace	2	1
Amherst	Local, very slight	Trace	1	0
Augusta	Rather general, moderate, occasionally severe	Trace-20%	14	10
Bath	Local, very slight	Trace	1	1
Bedford	Local, very slight	Trace-.5%	5	0
Botetourt	None found		0	
Brunswick	None found		0	
Campbell	Local, very slight	Trace- 1%	7	1
Caroline	None found		0	1
Carroll	Local, very slight	Trace	1	0
Charles City	Local, very slight		1	0
Chesterfield	None found		0	
Clarke	Local, very slight	Trace	1	2
Culpeper	None found		0	2
Cumberland	None found		0	
Dinwiddie	Local, very slight	Trace- 3%	2	0
Fairfax	Rather general, moderate, occasionally severe	Trace-10%	5	1
Fauquier	Rather general, moderate	Trace-5%	8	11
Fluvanna	Very general, severe	Trace-30%	22	2
Franklin	Local, very slight	Trace	1	2
Frederick	Local, very slight	Trace	2	2
Giles	None found		0	
Goochland	None found		0	
Greene	Local, very slight	Trace	1	0
Greensville	None found		0	1
Halifax	None found		0	
Hanover	Local, very slight	Trace	1	0
Henrico	None found		0	
Henry	Local, very slight	Trace-1%	3	0
Highland	None found		0	
James City	None found		0	
King George	None found		0	
King and Queen	Scattered, moderate, occasionally severe	Trace-10%	3	1
King William	Local, very slight	Trace	1	0
Lee	None found		0	

Counties	Infection			
	Severity in 1919			Number of records in previous years
	General condition	Range	Number positive cases	
Loudoun	General, moderate, occasionally severe	Trace-25%	14	3
Louisa	Scattered, very slight	Trace	2	2
Lunenburg	Local, slight, occasionally severe	Trace-7%	2	1
Mecklenburg	Local, very slight	1%	1	0
Montgomery	Local, slight	Trace-3%	5	11
Nelson	Rather general, slight, occasionally severe	Trace 30%	6	0
Northumberland	None found		0	
Nottoway	None found		0	1
Orange	Scattered, slight, occasionally severe	Trace-30%	4	0
Page	Scattered, very slight	Trace	2	4
Patrick	None found		0	
Pittsylvania	Rather general, slight	Trace-2%	7	0
Powhatan	Local, very slight	Trace	3	1
Prince Edward	None found		0	
Prince George	None found		0	
Prince William	Local, slight	Trace-1%	3	1
Pulaski	Local, very slight	Trace	2	0
Rappahannock	None found		0	
Richmond	Local, very slight	Trace	1	0
Roanoke	None found ?		0 ?	
Rockbridge	Local, very slight	Trace	1	6
Rockingham	Very general, very severe	Trace-70%	76	70
Russell	None found		0	
Shenandoah	Rather general, severe	Trace-30%	12	11
Smyth	None found		0	
Southampton	None found		0	
Spotsylvania	Scattered, very slight	Trace	3	2
Stafford	Scattered, slight	Trace	3	6
Surray	None found		0	
Sussex	None found		0	
Tazewell	Local, very slight	Trace	1	0
Warren	Local, very slight	Trace	1	0
Washington	Local, very slight	Trace	1	0
Westmoreland	Local, very slight	Trace-2%	1	0
Wise	None found		0	
Wythe	Rather general, slight	Trace-2%	7	6

The summaries of data in the preceding table are largely taken over from a similar table prepared by F. D. Fromme in his report on the 1919 cooperative nematode disease survey in Virginia. In this report Fromme comments on the general situation in Virginia as follows:

> "The disease is now known to occur to some extent in all sections of the state. It is most general and severe, as previously noted, in the Valley and Piedmont sections, especially in the counties of Rockingham, Shenandoah, Augusta, Albemarle, Fluvanna, Fauquier, Loudoun, and Stafford. The only counties in southwestern Virginia that show any appreciable amount of the disease are Montgomery and Wythe.
>
> "There is considerable evidence to show that the disease has been introduced rather recently into the lightly infested counties from counties where infection is general and of long standing. For example, most of the known cases in Pittsylvania County have been traced to a single purchase of wheat from the Valley. In these lightly infested counties the disease occurs in localities, having been introduced by a farmer who later sold seed to his neighbors.
>
> "It seems important in connection with efforts to reduce the amount of disease in the more generally infested counties that steps should be taken to prevent further introduction of the pest into the lightly infested counties. This may be accomplished in part by educational work, but to be fully effective should, in my opinion, be backed by restrictive measures.
>
> "The nematode disease is now known to occur in over half of the counties of the state. It is quite probable that it occurs to some extent in a number of the remaining counties. At any rate it seems only a question of time, under the present unrestricted movement of wheat, until it shall become established in all counties."

In West Virginia 36 towns and 17 counties were visited by the cereal disease survey men and collaborators, and the disease is reliably reported from two additional counties. The counties inspected were, first, those along the Virginia border from some of which the disease was reported the preceding year, and second, a number of counties in the Ohio River Valley, the principal wheat growing section of the state. Altogether the disease was found in four counties from which it had not been previously reported. All of these are on or near the Virginia border. No infections were found in the Ohio River Valley.

In Table 10 is summarized the data at hand for the counties from which reliable data is available. The same usage of terms is followed as for Virginia.

The most severe infections seem to be in Pendleton and Hardy Counties. This is as might be expected since these counties join two of the most heavily infested counties in Virginia, namely; Rockingham and Shenandoah. While most of the seed wheat is home grown in these counties, it was definitely learned in one case, where a farmer's wheat was found infected, that he had purchased the seed across the state line in Shenandoah County, Virginia. After the disease is introduced in a community it gradually spreads.

It is of especial interest also to note that a certain milling firm in Hardy County reported that the disease has been present there for about fifteen years; some years as much as a peck of nematode galls per bushel of wheat had been found.

The suspicious report regarding the occurrence of the disease in North Carolina, mentioned in Plant Disease Bulletin, Supplement 4: 134, 1919, has not been followed up as yet. Two incidental inspections were made at Garysburg, Northampton County, North Carolina, with negative results.

Table 10. Summary of data on the occurrence of the nematode disease of wheat in West Virginia.

Counties	Infection			
	Severity in 1919			Previously recorded
	General condition	Range	Number of positive cases	
Berkeley	None found			
Cabell	None found			
Grant	Local, rather severe	3	1	+
Greenbrier	Scattered, slight	Trace-1%	6	+
Hampshire	Local, slight	Trace-2%	1	
Hardy	General, severe	Trace-5%	4	+
Jackson	None found			
Jefferson	Local, very slight	Trace	1	+
Marshall	None found			
Mercer	Scattered, slight	Trace	3	
Mineral	Rather general	Trace-2%	3	
Monroe	Present. No data as to severity			+
Morgan	None found			
Nicholas	Present. No data as to severity			
Pendleton	Present. No data as to severity			+
Ohio	None found			
Pleasant	None found			
Summers	Scattered, very slight	Trace	3	
Wood	None found			

An incidental inspection was also made at Delta, York County, Pennsylvania, with negative results.

In Ohio, inspections were made at two mills in Gallipolis, Gallia County, and wheat nematode galls were found in wheat screenings at both places. In both cases the millers stated that the wheat from which the infected screenings had been removed was Ohio wheat, although considerable wheat from West Virginia is also marketed there. The evidence, therefore, as far as it goes, indicates strongly that the disease is becoming established in southern Ohio. Unfortunately, the discovery of this infection in Ohio was made just at the close of the nematode disease survey, so that it was impossible to follow up the matter farther at that time, much as it deserved to be.

In addition to the surveys in the eastern states, as mentioned above, L. P. Byars, of the Office of Cotton, Truck and Forage Crop Disease Investigations, in cooperation with the Office of Cereal Investigations, made a special survey for the disease in the central and western states in the summer of 1919, with negative results throughout. It is of especial interest to note that the disease did not perpetuate itself in California where it occurred in 1917. As bearing on this, W. W. Mackie reported that the field at Red Bluff, California, where the disease had occurred in 1917, was left unplowed and allowed to grow up to volunteer wheat in 1918; hence ideal conditions for reinfection if such were possible. Professor Mackie inspected this volunteer wheat himself July 1918, but found no nematode infection whatever there. It was thought that the seed for the preceding crop, in which the disease had occurred, had been imported, but definite information was not obtainable as to the source. Indications are, therefore, that the very dry, hot summer conditions common to the Red Bluff section of California, proved too severe for the parasite. The whole situation, however, suggests that there may possibly be some place on the Pacific Coast where the disease is occurring. That is, the place from which the infested seed, referred to above came.

The estimated percentage of loss for Virginia and West Virginia is about 5%. These losses summarized in bushels are given in Plant Disease Bulletin, Supplement 12, 1920.

While as yet the actual losses from this disease are comparatively small, yet on the whole, the disease cannot but be regarded as a threatening menace to wheat culture, especially winter wheat culture in the United States, and hence should merit all possible precautionary and control measures. It is not yet known how the disease will behave in the spring wheat area.

In connection with investigations carried on by the Office of Cereal Investigations, certain wheat varieties are showing promising indications of resistance to the disease. Experience is showing that the disease is not difficult to control. Clean seed sown on uninfested fields, even in infested localities has been shown to produce a perfectly clean crop, this even when close to infested fields. It is not yet known how long the parasite is able to remain viable in infested soils in the central and eastern states.

Black chaff caused by Bacterium translucens var. undulosum S. J. & R.

Black chaff of wheat was reported from a somewhat wider area in 1919 than in the preceding year. In 1919 it was reported from the following states: California, Idaho, Colorado, North and South Dakota, Minnesota, Wisconsin, Nebraska, Iowa, Illinois, Indiana, Kansas, Missouri, Texas, Oklahoma, Arkansas, and Virginia. Negative reports were received from Washington, Oregon, Montana, New Mexico, Georgia, Kentucky, and Michigan.

As to general prevalence and severity the following reports have been received:

Arkansas: "Present in most fields. No evidence of injury." Elliott.

California: Found in one field.

Colorado: "Several isolated cases reported during June - mostly from irrigated sections of south central part of state. Not very severe in any case." Leach.

Idaho: "Only one authentic collection." Hungerford.

Indiana: "Not prevalent." Gardner.

Iowa: "Most severe on winter varieties." Melhus.

Kansas: "This disease was reported from practically all sections of the state in greater or less quantities. It is very difficult to estimate, or even approximate the amount of injury this disease might have caused." Melchers.

"Common in most fields. Present in only traces in many fields. Low spots had often times quite serious infection. Not as common or serious as in 1915." Melchers.

Missouri: One field in Scott County was reported as showing 100% infection. Injury not noted.

Montana: "In no instances have typical cases of this disease been found even in districts where the disease caused from 50-90% reduction in yield last year. Occasional leaf lesions seen which might have been caused by the black chaff organism." Jennison.

North Dakota: "This disease not present in destructive form: only traces apparent in fields examined by me." Bolley.

Oklahoma: "I collected this disease for the first time in 1917 in Payne County, just a short distance from the College, and this summer the same field was badly infected again. It is very common in this county, and in the early season it caused a great deal of injury. During the summer, in going over the state, I found it in many fields where the county agent did not know what it was, and had noticed it in the early season, probably quite common. In one instance we went to one of the stacks and I pulled out a handful of plants consisting of 47, and 40 of them showed the disease. This county (Payne) was very low in yield, and they put it all to the wet weather, but I believe this disease had its part in the decrease." Learn.

South Dakota: "Two to five per cent in some fields; as a rule, less than 1%." Champlin.

On the whole, it is evident that the disease was most general and most severe in Iowa, Missouri, Kansas, and Oklahoma.

No cases of varietal resistance, nor control measures were reported.

Anthracnose caused by Colletotrichum cereale Manns.

Anthracnose of wheat was reported from practically all of the wheat growing sections east of the 100th meridian. It was also reported from Montana. In most states it was rather general, but for the most part, the losses were slight. However, in New Jersey, Virginia, Ohio, and Iowa, it is reported more severe, as follows:

New Jersey: "Very common and apparently destructive." M. T. Cook.

Virginia: "Very destructive locally, especially in south central part. I believe it is a disease of considerable importance for the state as a whole." Fromme.

Ohio: "Very abundant in vicinity of Wooster, Wayne County." Selby. "Experiment Station plots, continuous wheat culture, from 13 to 91% plants infected, infection moderate in severity." Freda Detmers.

Iowa: "Very common; favored by abundant moisture early in spring." I. E. Melhus.

On the whole it is evident that the disease was rather severe locally and that the total losses caused by it no doubt aggregated considerable, even though the average losses for the various states are comparatively low.

Selby reported that the wet formaldehyde seed treatment, (1 pint to 40 gallons) kills spores adhering to surface of grain.

Glume blotch and leaf spot caused by Septoria spp.

Both the Septoria glume blotch and Septoria leaf spot of wheat occurred widely in 1919. The glume blotch occurred most commonly from Indiana eastward and southward; also to some extent in Illinois, Iowa, Missouri, and Kansas. The leaf spot occurred throughout this area also, as well as farther west, throughout the Mississippi and Missouri Valleys, and particularly on the Pacific Coast, being definitely reported there from Washington, Oregon, Idaho, and California. Hungerford also reported, "Some damage to seedlings" in Idaho.

The following reports from the central and eastern states are of interest:

Alabama: "General throughout state. Ranging in severity from very slight to bad." G. L. Peltier.

Indiana: Glume blotch - "Very prevalent, associated with the leaf spot." Gardner.

Leaf spot - "Widely distributed throughout state, almost no fields being free from it. In few cases, however, did it seriously reduce the yield." Gardner.

Iowa: "Found to a high percentage on winter wheat at Agronomy farm at Ames. Very common early in the spring. By this time (June 10) it has worked up the stems to the upper leaves. Trace on glumes." A. L. Bakke.

"Very common; causing seedling blight." I. E. Melhus.

Kansas: Glume blotch - "Caused injury in some fields. Low spots and lodged wheat had worst infection. Although not as widely spread as black chaff, the injury was just as severe in many fields." L. E. Melchers.

Leaf spot - "This disease became conspicuous in some fields in the fall of 1918 and was very prevalent in the spring of 1919, when many of the fields began to turn yellow. It is stated that some fields were plowed up on account of this trouble in southeastern Kansas. For the most part, fields showing infection outgrew the trouble. It appeared again when the plants began to head. This disease has been quite frequently confused with the black chaff disease." L. E. Melchers.

Ohio: Glume blotch - "Rather prevalent at Station (Wooster); no damage. Appears to be quite general over state." A. D. Selby.

Leaf spot - "General and moderately severe during late spring over southwestern and central Ohio. Also marked occurrence at Experiment Station, Wooster." A. D. Selby.

Virginia: Glume blotch - "Septoria on wheat heads unusually prevalent. Incessant rainfall at heading evidently farored development. Reported from many places where farmers had never noticed it before." Fromme.

West Virginia: "Quite a little Septoria infection has been observed in many fields." N. J. Giddings.

The glume blotch was reported also on spelt from Minnesota.

Powdery mildew caused by Erysiphe graminis De C.

Powdery mildew on wheat was more severe in 1919 than usual, especially early in the season in certain of the Atlantic Coast states. This was no doubt chargeable to the unusually mild winter. It was definitely reported from the following states: Washington, Idaho, California, Montana, Kansas, Minnesota, Iowa, Illinois, Indiana, Ohio, Kentucky, Tennessee, West Virginia, Pennsylvania, New York, and Connecticut.

The following reports from Iowa, Kansas, and West Virginia are of interest:

Iowa: "Found where wheat is lodged and where stand is heavy." Bakke.

Kansas: "This was very common in May and June in the wheat crop over the state. It did no damage and ceased spreading after the rainy season passed." Melchers.

West Virginia: "Wheat mildew has been unusually prevalent and has caused some little injury in many wheat fields this year." N. J. Giddings.

Ergot caused by Claviceps purpurea (Fr.) Tul.

Ergot on wheat in 1919 was reported from Illinois (one field, slight infection), Indiana (rare), Minnesota, North Dakota, and Wisconsin. In Minnesota it was reported from Olmstead, Goodhue, Dakota, Hennepin, and Ramsey Counties. In Ramsey County it was reported as having occurred on a number of varieties. In North Dakota the disease was reported from the eastern half of the state, but as most common in the southeastern portion. In Wisconsin ergot on wheat occurred in Rock, Dane, Columbia, La Crosse, St. Croix, and Burnett Counties. In Rock County one field was noted by J. G. Dickson where about 2% of the heads were infected. It is suggested by R. E. Vaughan that possibly ergot may be increasing on wheat in Wisconsin.

Helminthosporium blight caused by one or more species of Helminthosporium.

In Minnesota a seedling blight on both Marquis and durum wheat caused by Helminthosporium sp., was reported as destructive late in May in the Red River Valley and more or less elsewhere in that state. The following note by the Section of Plant Pathology, Minnesota Agricultural Experiment Station, is of especial interest: "Many fields were complete failures at seedling stage and the ground was plowed and planted to flax. Those plants which survived became normal and the fields probably produced a fair crop."

In North Dakota these wheat troubles were reported especially from the eastern half of the state. Bolley reported as follows:

> "This root and seedling trouble has been very destructive throughout the year and generally throughout the state in fields and regions of rather constant cropping, and destructiveness in many cases depends largely on the condition of the seed sown. It is perhaps the most destructive, excepting scab in scab epidemic invasions. The species of Helminthosporium constitute perhaps the most destructive wheat disease in this state this year." (July 15.)
>
> "Very abundant and destructive. Particularly destructive in destroying stools and in the production of black points on the grain, injuring the grain throughout the state, particularly in connection with rather constant (wheat) cropping." (August 1.)

The following additional summary for North Dakota by Professor Bolley is also of importance as bearing on the situation:

> Wheat has suffered severely in this state from the beginning from root and seedling disease because of peculiar soil and atmosphere conditions. In the spring heavy rains, particularly in the valley (Red River) at seeding time, resulted in wet, badly baked land and in poor condition for the growth of the young plants. This was followed by intense drought resulting in stunting and blighting by hot winds followed again by heavy rains in certain regions. In other words, irregular growth conditions have emphasized the destructiveness of the soil and seed borne imperfect fungi, Fusarium, Helminthosporium, etc."
>
> "In durum wheats the parasite known as Helminthosporium has caused extremely large destruction in certain portions of the state this year in the way of destroying the grade of the durum wheat, particularly the varieties of red durum. This organism brings about an excess production of black point which tends to cause great injury to the quality of flour from the standpoint of color and texture."

In South Dakota Manley Champlin reported "Considerable evidence of infection by Helminthosporium on the glumes, especially of durum varieties; grains also affected."

It is conservatively estimated that these troubles caused a loss in North Dakota of about 2% and in Minnesota of about 1%.

Other diseases.

Basal glume rot of wheat caused by Bacterium atrofaciens McCulloch, recently described by Lucia McCulloch (Jour. Agr. Res. Vol. 18, No. 10, 543-551, 1920) is of especial interest. While no data are reported as to the occurrence of this malady in 1919, Miss McCulloch reports that the disease was found on specimens collected in 1917 and 1918 in the following states: Kansas, Michigan, Minnesota, Missouri, New York, North Dakota, Oklahoma, and South Dakota, and in Alberta, Canada.

Stripe (causes not determined). The so-called stripe of wheat was reported from Missouri, Illinois, Indiana, and New York.

A Rhizoctonia root rot of wheat was reported by E. A. Bessey from Michigan. It was said to occur especially in heavy soils.

Rhynchosporium graminicola was reported by Heald and Dana as attacking wheat in western Washington.

Alternaria sp. was reported on wheat from Howard county, Missouri and from Wayne County, Ohio.

Cladosporium sp. on wheat was reported by M. T. Cook as "Very abundant and apparently destructive" in New Jersey. It was also reported from Minnesota, Missouri, Ohio, and Washington. It may not be improbable that this Cladosporium is a saprophytic development following some more fundamental trouble.

"*White spot*", a wheat seedling disease of uncertain cause, was reported from the northwestern part of Minnesota. It is briefly described as follows by the Division of Plant Pathology of the Experiment Station: "An interesting disease, was very prevalent in the Red River Valley this spring. No insect nor fungus was found associated. A white band about 2 to 3 mm. wide appeared on the young leaves. The leaves would twist and curl at this point, eventually shrivel, and break off. This often so completely defoliated the plants that they died. Some fields were completely destroyed. Plants which survived the seedling stage grew normally. In some cases fields which looked very sick completely recovered after a rain."

Frost injury to wheat was reported as having caused about 1% loss in Idaho and 5 - 7% loss in Washington. These frost injuries took place after wheat was in head. Heald notes as follows from Washington: "Some fields complete loss, in others scattered, unfilled heads resulted, or blighted tips."

From Indiana, Gardner notes that "Freezing did a great deal of damage to Indiana wheat early in the spring. Much of this wheat did not recover and there is quite a reduction in yield." (July 15).

Injuries from spring freezes were also reported from Illinois, Michigan, and Missouri.

RYE

Stem rust caused by *Puccinia graminis* Pers

Stem rust of rye was reported as occurring in slight amounts from Colorado to New York, and from north to south in practically all of the intervening states where rye is grown. It was reported as causing distinct losses only in Minnesota, Wisconsin, Delaware, South Carolina and Georgia. In these states the percentages of loss were estimated at 2, 1, 10, 1 and 2% respectively. In the other states the losses were estimated as so slight as to be difficult to estimate with any degree of accuracy or entirely negligible. On the accompanying map are indicated the occurrence and the estimated percentages of reduction in yield in the states from which reports have been received. The estimated losses are summarized in bushels in Plant Disease Bulletin, Supplement 12, 1920.

In Wisconsin, consistently for a number of years, early and severe stem rust infections on rye have been noted as being distinctly associated with aecial infections on the common barberry, either directly, or through quack grass. In 1911 a striking case was observed where a field of otherwise fine rye was practically totally destroyed by stem rust. Two clumps of heavily infected barberries were at the roadside at the edge of the field. Another field of rye about ten miles distant, under similar growing conditions and no barberries anywhere near, had but very little stem rust in it, and the rust developed so late that a splendid crop of excellent quality was obtained. Since then numerous cases have been followed carefully from early spring on, and stem rust infections traced directly to infected barberries. Evidence seems to indicate, at least in Wisconsin, that when the common barberry is completely eradicated the development of stem rust on this crop coming from other sources will be so greatly delayed as to be of negligible importance.

No rust resistant varieties of rye were reported.

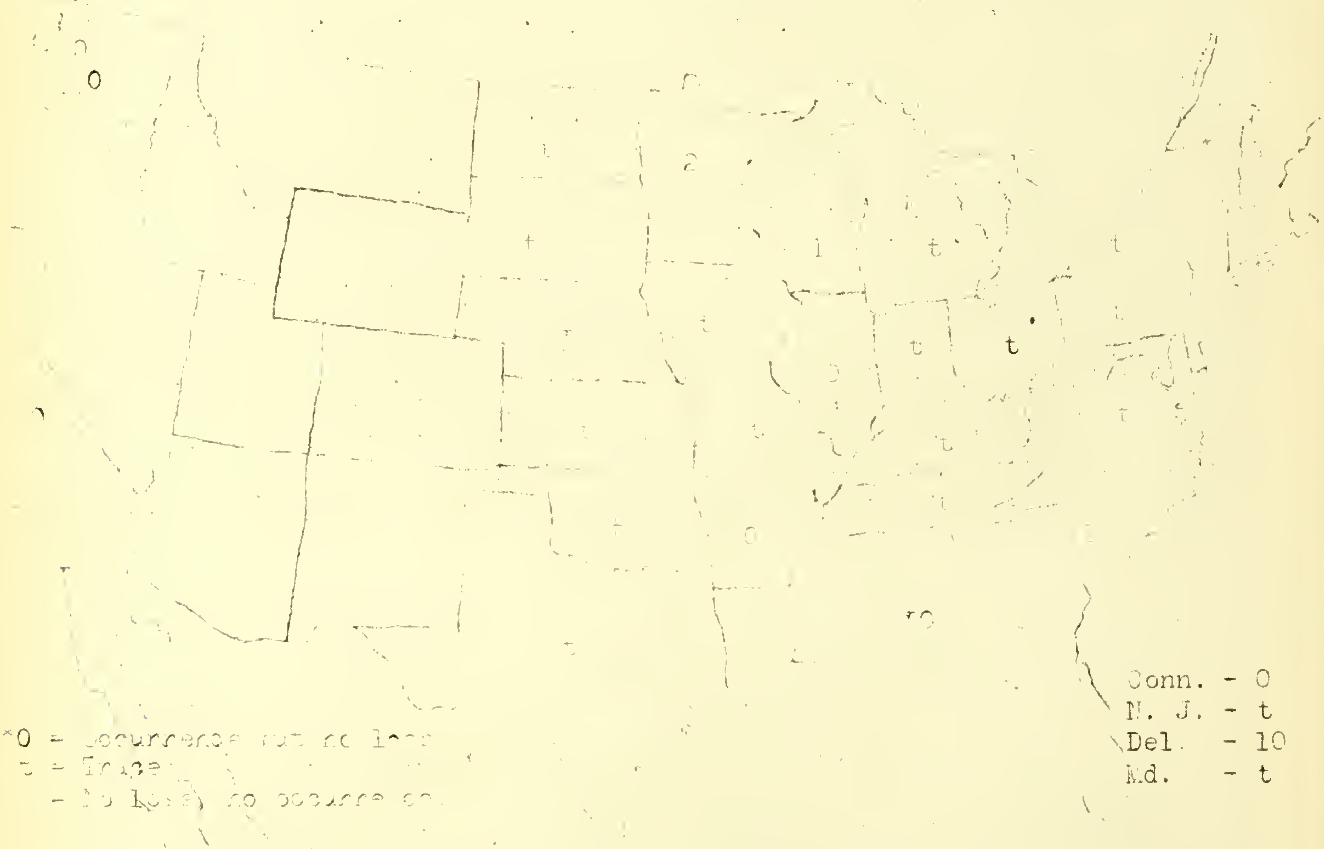


Fig. 8. Estimated percentage reduction in yield from stem rust of rye, 1919.

Leaf rust caused by *Puccinia dispersa* Erik.

Leaf rust of rye occurred widely distributed in 1919 as usual, and caused marked losses, especially in certain southeastern and eastern states, as is shown on the accompanying map. The severity of the attacks by this disease seems to have been accentuated, as in the case of the leaf rust of wheat, by the unusually open preceding winter. The estimated losses are summarized in bushels in Plant Disease Bulletin, Supplement 12, 1920.

On winter rye the rust was first noted May 30 in Minnesota and June 1 in Wisconsin. The only early report on spring rye was June 17, in Minnesota.

No outstanding cases of varietal resistance to the disease were reported.

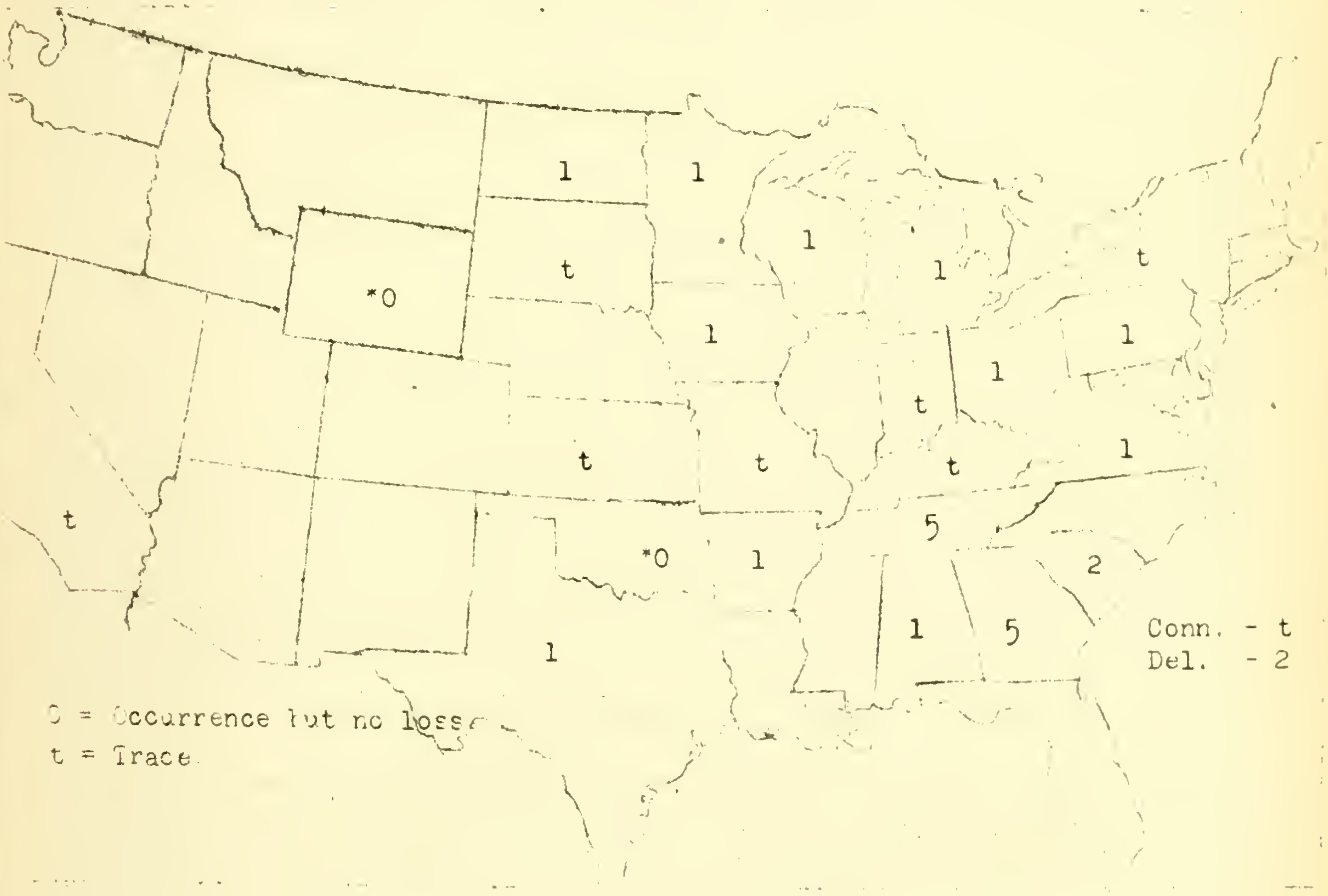


Fig. 9. Estimated percentage reduction in yield from leaf rust of rye, 1919.

Scab (blight) caused by *Gibberella saubinetii* (Mont.) Sacc.

Scab (blight) of rye was considerably more common and more destructive in 1919 than in preceding years. This disease was reported as causing marked losses in South Dakota, Minnesota, Wisconsin, Iowa, Missouri, Illinois, Indiana, and Virginia. Very slight losses were reported from Delaware, Kentucky, Tennessee, Arkansas, and Oklahoma. A number of unusually severe infections were reported. One field in Minnesota had 97% scab, one field in Illinois showed 90%, and one field in Missouri contained 65% scab. The disease was not reported from the western states. The distribution and estimated percentages of loss are indicated on the accompanying map. The estimated losses in bushels are summarized in Plant Disease Bulletin, Supplement 12, 1920.

It is to be noted that the area of greatest losses coincides very closely with the corresponding area for wheat scab. This might be expected, since rye is known to be susceptible to the attacks of the same parasite which is the main offender in the case of wheat scab. Hence the same factors were operative on rye as on wheat, as previously presented.

As to the relation of severe cases of scab on rye and previous crops on these fields, it is particularly noteworthy that two rye fields, one in Minnesota and one in Illinois, where unusually high percentages of scab were noted; namely 97% and 90% respectively, both had been in corn the preceding year. Comparatively high percentages of scab on rye were also noted in Missouri where the previous crop had been corn.

No outstanding cases of resistance were reported, nor were any other practicable control measures.

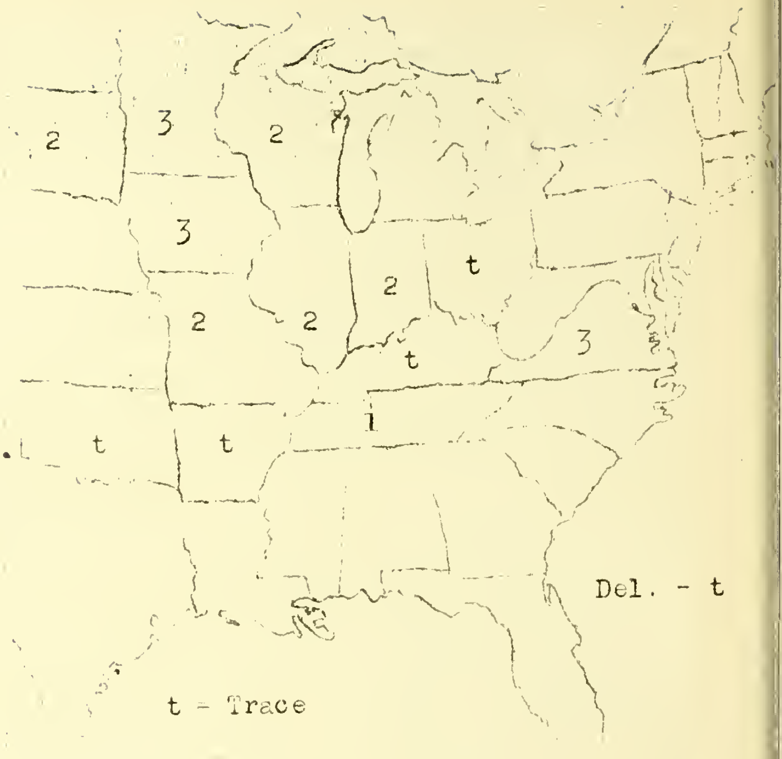


Fig. 10. Estimated percentage reduction in yield from scab of rye 1919.

Anthracnose caused by Colletotrichum cereale Manns.

Anthracnose on rye was reported as having occurred in a number of important rye producing states in 1919, in some states in considerable amounts. The disease was definitely reported from Minnesota, Wisconsin, Iowa, Missouri, Illinois, Indiana, Ohio, Pennsylvania, Virginia, Tennessee and Alabama. It was reported as severe in southern Virginia, Alabama, southern Indiana and different parts of Iowa and Ohio.

In Alabama it was said to be the "worst disease of rye in the state" by E. F. Hopkins. In the Experiment Station plots at Auburn the disease was reported as unusually severe by G. L. Peltier. He has kindly furnished the following data.

Table 11. Relative amounts of anthracnose in certain varieties of rye, Auburn, Alabama, May 20, 1919.

Plot No.	Varieties	Percentage anthracnose	Plot No.	Varieties	Percentage anthracnose
1	Florida	25 - 40	5	Georgia	25
2	Rosen	59	6	Piedmont	50
3	Abruzzi	25	7	Florida	25
4	Ordinary	50	8	Tuscaloosa	25

NOTE. "Of all the rye varieties, Abruzzi, Florida and Tuscaloosa are the most promising under Alabama conditions as far as anthracnose is concerned. The Tuscaloosa rye is apparently the best."

In Iowa it was reported as very common and as having caused 5% reduction in yield.

Fortunately the disease seems to be less severe in the northern states where rye production is more important than southward.

Powdery mildew caused by Erysiphe graminis De C.

Powdery mildew on rye was reported in 1919 from Georgia (Washington County), Iowa (Benton County, common in the bottom lands), and Minnesota (Ramsey County).

Stem smut caused by Urocystis occulta (Wallr.) Rab.

Stem smut of rye was reported from North and South Dakota, Nebraska, Kansas, Minnesota, Wisconsin, Iowa, Missouri, Illinois, Indiana, Michigan, Ohio, Pennsylvania, Virginia, South Carolina, Georgia, Texas, and Arkansas. In each of these states it was reported as very slight or a trace. In Minnesota, where it seems to be most general, it was reported as "General but very light this year." At Manhattan, Kansas, Melchers reported, "Only slight amount on Agronomy nursery in grain from shipped in seed." Champlin made a similar report from South Dakota as follows: "A trace in Rosen rye from Michigan. None in native rye."

Head smut caused by Ustilago sp.

Head smut of rye, previously noted in Indiana, Tennessee, and Virginia, was reported by C. T. Gregory as having occurred in two fields in St. Joseph County, Indiana, June 4, 1919. He reported it as very rare.

Ergot caused by Claviceps purpurea (Fr.) Tul.

Ergot on rye was reported in 1919 from all of the Upper Mississippi Valley states and west to North and South Dakota, Nebraska, and Kansas, and east to, and including, West Virginia and Pennsylvania. In a number of states it was reported as slightly less than the preceding year. The following reports are of especial interest:

Illinois: "Ergot does not seem to be as abundant as last year, but I have observed 60% infection in fields where volunteer rye has appeared in clover and wheat." H. W. Anderson.

Iowa: "Common. Ergot also very common on wild grasses." I. E. Melhus.

Kansas: "It is interesting to call attention to the fact that ergot of rye occurs very rarely in this state, although a very small acreage of rye is planted, still the amount of ergot that is found is very small in proportion to the acreage." L. E. Melchers.

Michigan: "Common, but not doing very much damage. Brine treatment coming into use." E. A. Bessey.

North Dakota: "Ergot is reported from many parts of the state and it has been observed in numerous fields, but not quite as pronounced this year in this region as in previous years. However, it is sufficiently abundant to indicate, as in previous years, that this disease is to become one of the most destructive and difficult to handle of the rye troubles in this state." H. L. Bolley.

West Virginia. "Specimens collected in Monongalia County and about 5% of heads infected in the field examined." N. J. Giddings.

Wisconsin: "More ergot than for several years. One field in Outagamie County showed 95% of plants having one or several sclerotia to the head." R. E. Vaughan.

Other Diseases

A bacterial disease on rye was reported from Idaho by Hungerford.

Septoria was reported on rye from Texas, Minnesota (leaves and nodes), Wisconsin (leaves), Ohio (leaves), and Indiana (heads).

Rhynchosporium blight caused by Rhynchosporium secalis (Heins.) Davis was reported by Heald and Dana from western Washington. It also occurred in Wisconsin.

Helminthosporium sp. was reported as attacking rye stems in Oklahoma and Minnesota.

Epicoccum sphaerosporium was reported on rye from Minnesota.

"Broken stem" disease of rye presumably caused by an associated species of Mycosphaerella was reported from Sandusky County, Ohio by Freda Detmers.

Sterility in rye, cause not determined, was reported by J. L. Seal as causing marked losses (as high as 50%) in certain fields in South Carolina.

BARLEY

Covered smut caused by Ustilago hordei (Pers.) K. & S.

Covered smut of barley was reported as having occurred very generally throughout barley growing sections as in previous years. From a few states the losses from this disease were reported as a little less than the preceding year. On the whole, however, they are comparatively low except in a few states.

In a number of individual fields in different states rather high percentages of covered smut of barley were noted in the course of the cereal disease survey as follows:

Table 12. Highest percentages of covered smut of barley in individual fields as noted in the cereal disease survey in 1919.

States	Highest %	States	Highest %
New York	2	Minnesota	20
Pennsylvania	4	Iowa	4
Virginia	3	Missouri	3
Kentucky	15	North Dakota	t
Tennessee	10	Nebraska	3
Alabama	2	Kansas	2
Texas	60	Montana	2
Oklahoma	20	Colorado	5
Ohio	15	Idaho	25
Indiana	8	Washington	12
Wisconsin	3	California	32

On the accompanying map are indicated the estimated percentages of reduction in yield where the disease was reported. These losses summarized in bushels are given in Plant Disease Bulletin, Supplement 12, 1920.

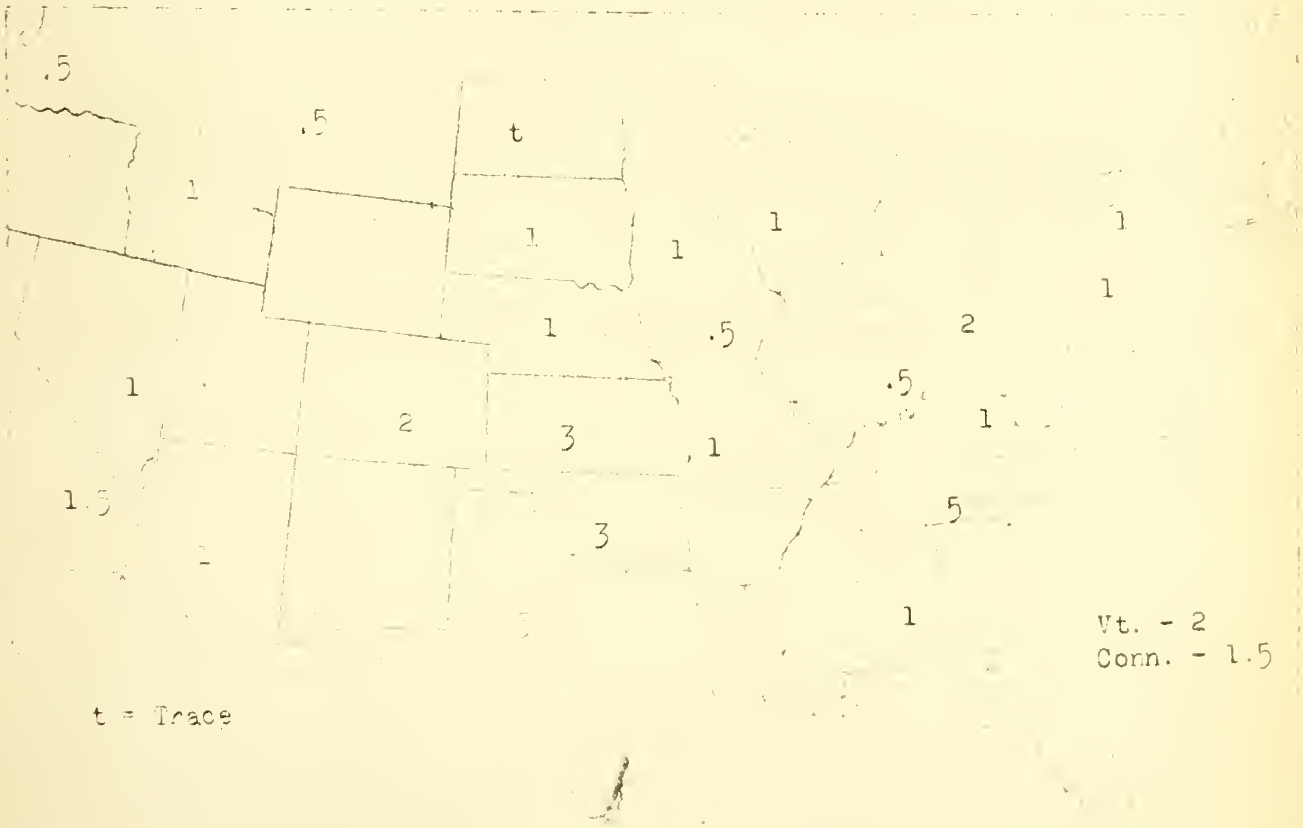


Fig. 11. Estimated percentage reduction in yield from covered smut of barley 1919.

In some states the losses from this disease exceed those from the loose smut of barley and in others the reverse seems to be true. In a number of states the losses from these two smuts are about equal.

From Montana, H. M. Jennison reported that this disease was less in 1919 than usual, "partly, it would appear, on account of the extreme dryness throughout the season and partly on account of more general and successful control treatments."

No outstanding cases of varietal resistance were reported. However, from Minnesota it is reported by the Section of Plant Pathology of the College and Experiment Station that Manchuria barley was found more heavily smutted than Six Row barley (Manchuria av. 1.4%; Six Row av. .7%).

As for control measures the formaldehyde wet method was the most common seed treatment except in California where the copper sulphate method also was used extensively. The formaldehyde dry method was reported effective from Kansas and Washington as follows:

Kansas: "The dry formaldehyde method will control the covered smut of barley and seems quite advisable for use in controlling this disease." L. E. Melchers.

Washington: In comparing effectiveness of the wet and dry methods of formaldehyde seed treatment for barley Heald reported: "Best results with dry method experiment of 1919."

Loose smut caused by Ustilago nuda (Jens.) K. & S.

Loose smut of barley, although generally present, was reported from a number of states to have been somewhat less destructive in 1919 than usual. While the percentages of loose smut found in the course of the cereal disease survey were commonly low, a number of rather unusually high percentages were noted. These being of especial interest are given by states in the following table:

Table 13. Highest percentages of loose smut of barley in individual fields as noted in the cereal disease survey in 1919.

States	Highest %	States	Highest %
New York	5	Iowa	30
Pennsylvania	2	Missouri	4
Kentucky	2	Nebraska	3
Tennessee	4	Kansas	3
Texas	65	Montana	3
Oklahoma	4	Colorado	1.3
Ohio	25	Idaho	1
Indiana	25	Washington	1
Wisconsin	8	California	50
Minnesota	20		

On the whole, loose smut of barley was more severe than covered smut particularly in Indiana, Ohio, and Kentucky. In certain other states it was less severe and in still others about the same.

On the accompanying map are indicated the estimated percentages of reduction in yield where the disease was reported.

No differences of varietal susceptibility were reported. Control measures such as the modified hot water method of seed treatment are apparently but little used.

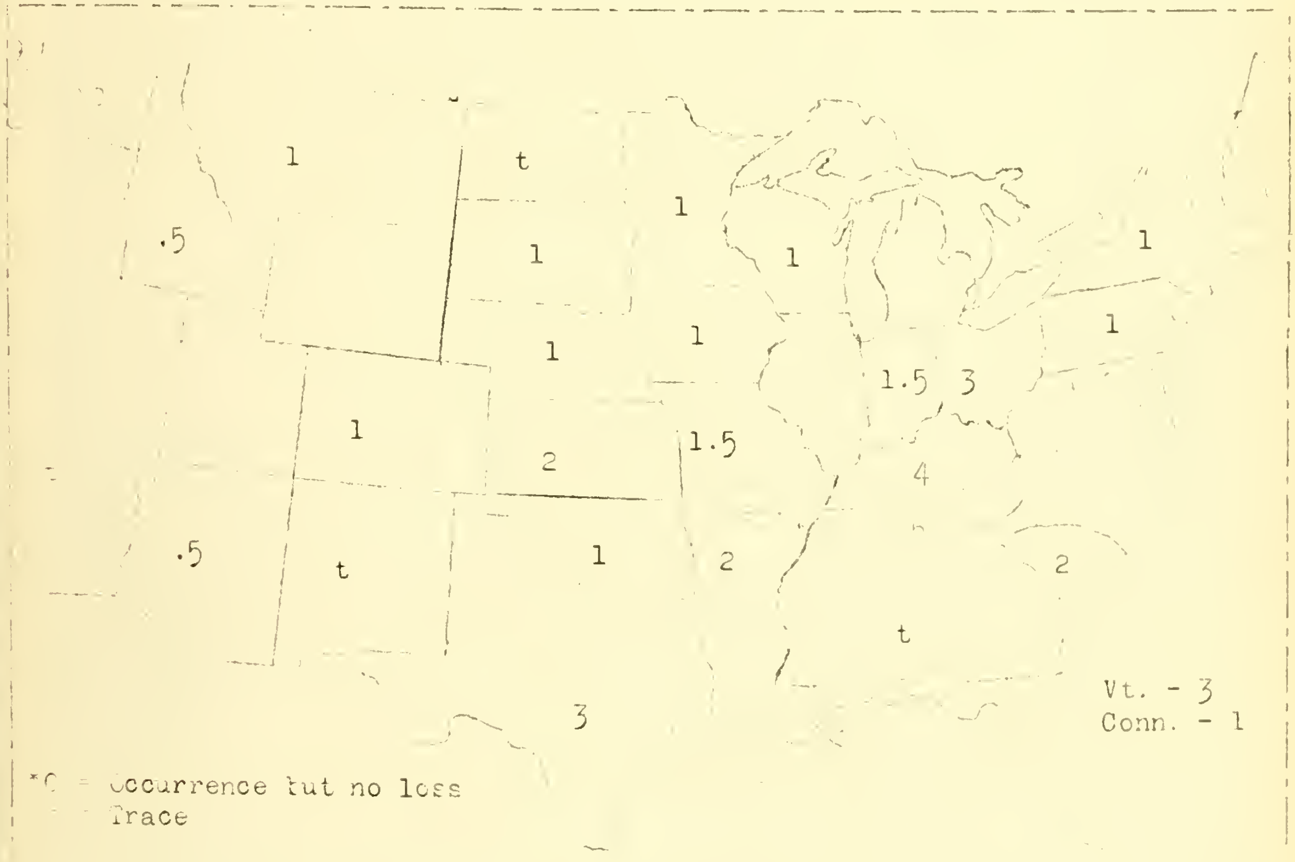


Fig. 12. Estimated percentage reduction in yield from loose smut of barley, 1919.

Stripe caused by *Helminthosporium gramineum* Rab.

Stripe of barley was reported from a number of states in 1919. In some states, particularly Iowa and Colorado, it was reported as severe. In Wisconsin the disease was much less severe than for a number of years. From Iowa, R. C. Cromwell reported finding fields with as high as 35% of plants destroyed by stripe. In Colorado, Leach reported that in "a few fields as high as 25% of plants were completely killed". From Michigan, G. H. Coons reported, "Barley stripe common; early attack exceptionally severe".

On the accompanying map are indicated the estimated percentages of reduction in yield in states from which reports were received. It is of especial importance to note that this disease is occurring not only in the North on spring barley, but also in the South on winter barley.

While it is well known that this disease is seed borne, it is of especial interest when data is secured on its introduction into new sections. Two such bits of data were received in 1919. L. E. Melchers reported from Kansas that "The stripe disease of barley was found in some parts in the college nursery, seed having been sent in from some other state. None of the barley *Helminthosporium* diseases have ever been found occurring in any of the commercial fields." L. H. Leonian reported from New Mexico that the disease was particularly severe in Dona Ana County, in the southern part of the state, and that it had been traced to infected seed bought from a Colorado seedsman and distributed among farmers of that County.

The disease is difficult to control completely by any of the standard seed treatments. The long soak, wet formaldehyde method is best. To secure best control the seed should be well cleaned first, then soaked in a 1 pt. to 30 gal. formaldehyde solution for at least two, and preferably three, hours. This good barley will stand. The hot formaldehyde method is used in Iowa to some extent. Other formaldehyde treatments as well as hot water and copper sulphate methods reduce the disease markedly, but usually do not eliminate it.

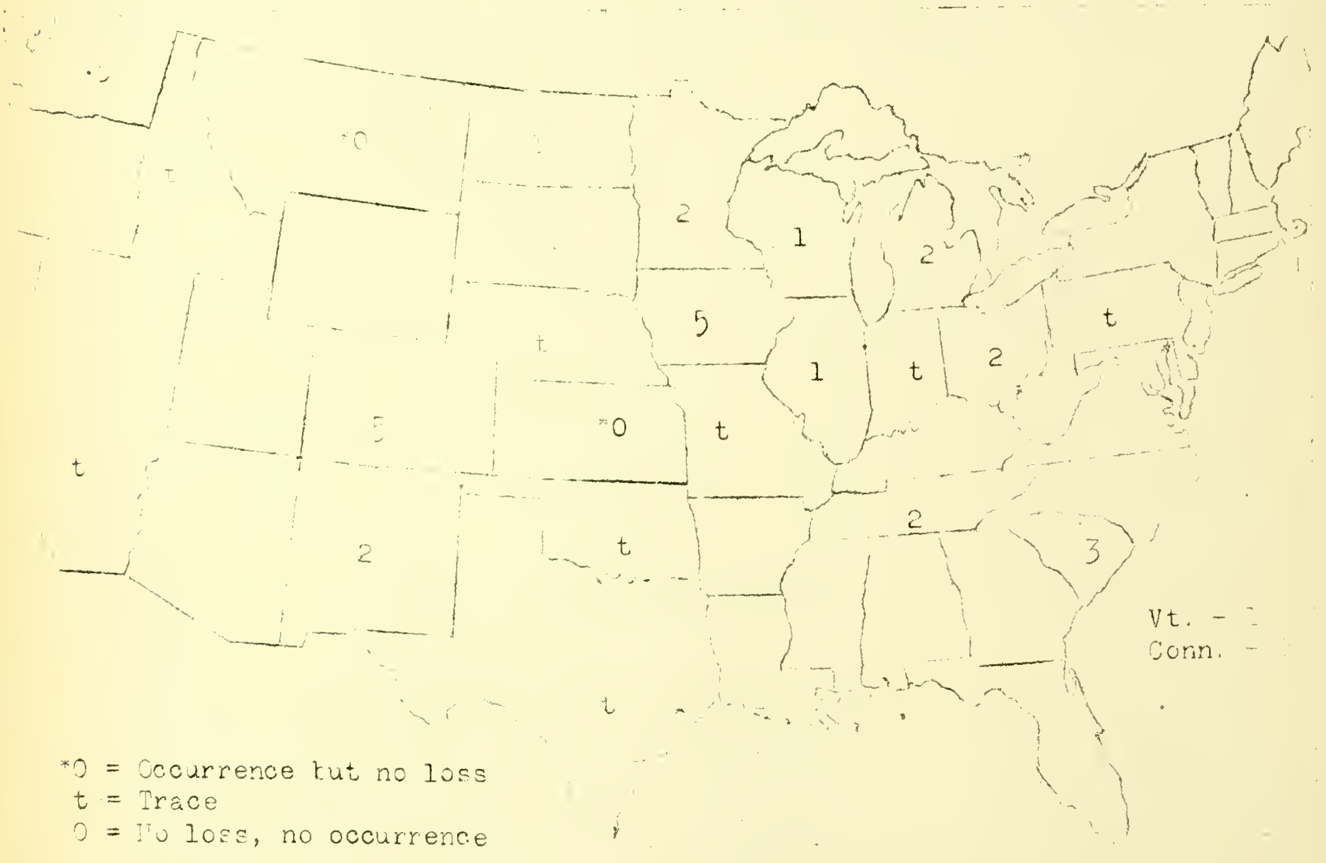


Fig. 13. Estimated percentage reduction in yield from stripe of barley, 1919.

Stem rust caused by *Puccinia graminis* Pers.

Stem rust of barley caused marked losses in the important barley production area of the Upper Mississippi Valley in 1919. In other sections losses from this disease were small. On the accompanying map are indicated the range of occurrence and percentages of estimated loss in the various states where losses were reported. The estimated losses are summarized in bushels in Plant Disease Bulletin, Supplement 12, 1920.

In general, the range of the more severe losses coincides rather closely with those caused by the same species of fungus on wheat and rye. This, no doubt, is chargeable to the fact that barley is a common host to the specialized races of this rust on wheat and rye. The losses from attacks of stem rust on barley, while considerable, are not excessive, due in general to the early maturity of the crop.

No outstanding cases of varietal resistance were reported.

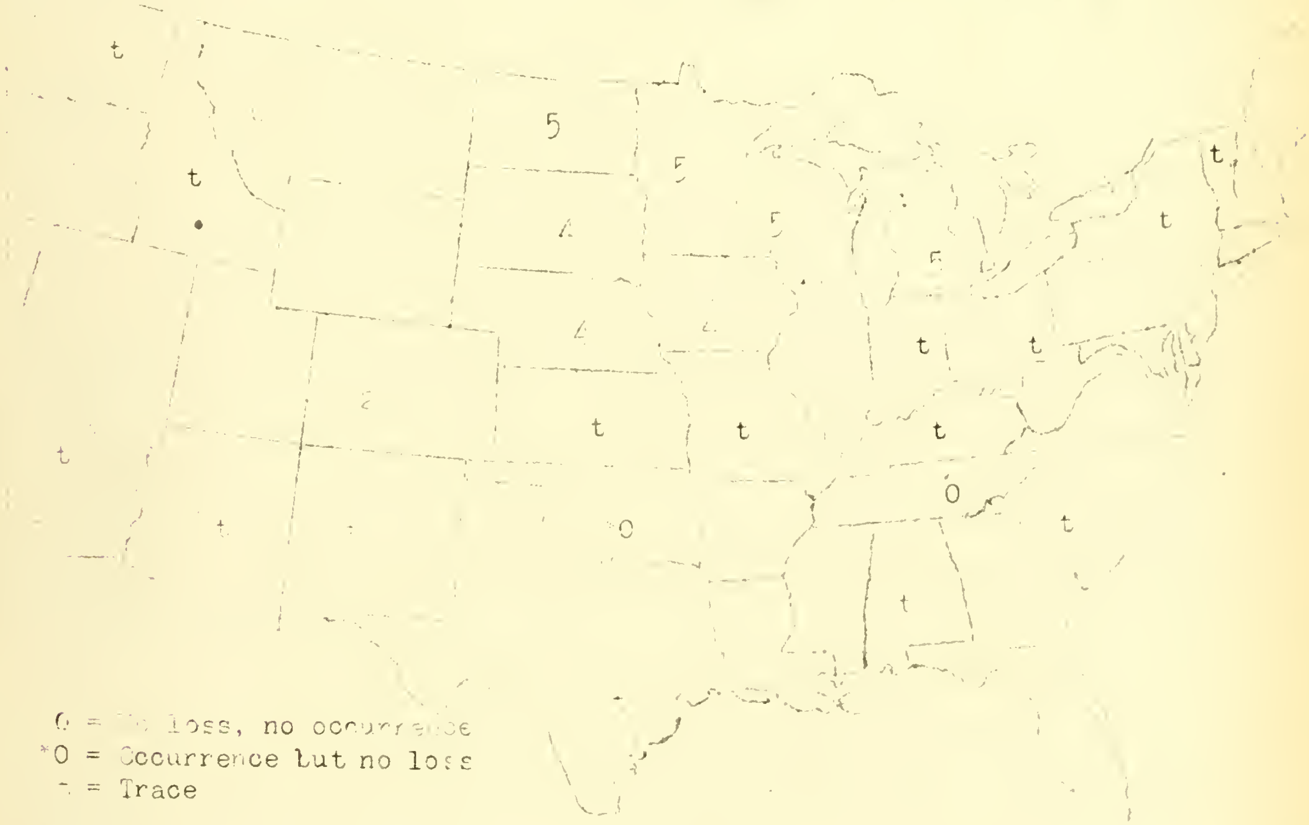


Fig. 14. Estimated percentage reduction in yield from stem rust of barley, 1919.

Leaf rust caused by _Puccinia simplex_ (Koern.) Eriks. & Henn.

The leaf rust of barley, while rather widely distributed during 1919, was reported as causing no appreciable losses except in Pennsylvania, Tennessee, and California, as shown on the accompanying map. In the northern Mississippi Valley states this rust is most commonly seen on volunteer barley in the fall. In California, where barley is commonly sown in the fall, it becomes much more abundant in the regular crop. In that state it was reported most abundant in Monterey and Santa Clara Counties.

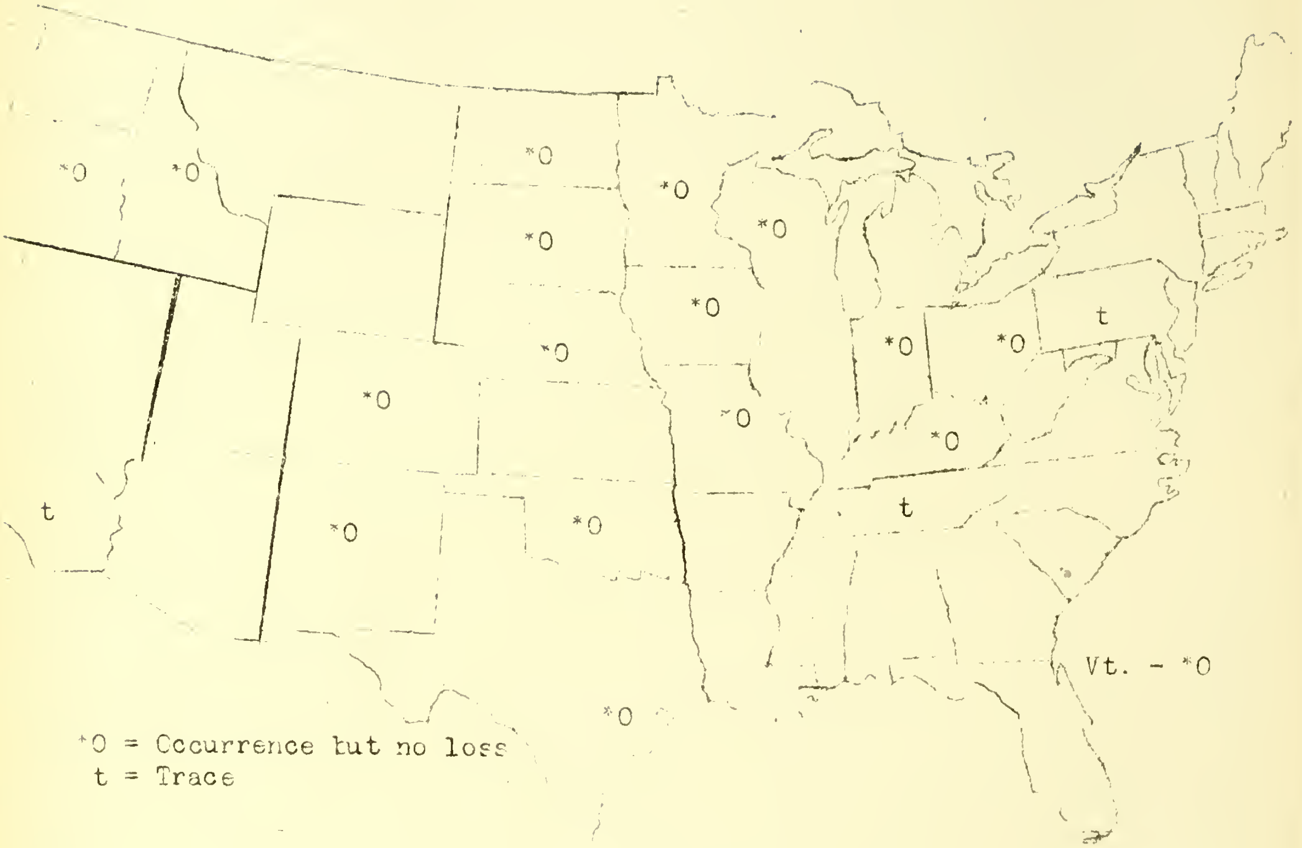


Fig. 15. Estimated percentage reduction in yield from leaf rust of barley, 1919.

Scab(blight) caused by Gibberella saubinettii (Mont.) Sacc.

Scab (blight) of barley was reported from a number of the Upper Mississippi Valley, Ohio Valley and nearby states in 1919, in contrast to very scattering reports heretofore. The earliest report of this disease from collaborators seems to be from Nebraska in 1907. In 1909 it was reported from Iowa; in 1915 from Minnesota; in 1918 from Iowa, Minnesota and Wisconsin; in 1919 from North and South Dakota, Minnesota, Wisconsin, Iowa, Missouri, Illinois, Indiana, Ohio, Pennsylvania, Kentucky and Tennessee. In Iowa and South Dakota the disease was reported as rather severe on barley on the average, and causing an estimated loss of about 3 - 5%. In Missouri, Kentucky and Tennessee losses were appreciable although slight, estimated at 1%. In a number of cases rather high percentages of scabbed barley heads were noted. Individual fields in Kentucky and Tennessee were observed where 50 and 40% of the heads were scabbed, respectively. In Minnesota the highest percentage noted was 30%; in Iowa 20%; in Missouri 10%. On the whole, the general infection area on barley coincides in general with that where the wheat scab epidemic was severe, hence it is not surprising that the disease on barley should have been found to occur more extensively in 1919 than heretofore.

As to relations of these high percentages of scab on barley to previous crops on those fields, it is particularly interesting to note that where these highest percentages of scab in barley occurred in Minnesota, Iowa and Missouri, the preceding crop, in each case, had been corn. In Tennessee, however, the preceding crop was reported as having been cowpeas.

Net blotch caused by Helminthosporium teres Sacc.

Net blotch of barley was reported in 1919 from a wider area than the preceding year. It was reported from California, Oregon, Idaho, Montana, North and South Dakota, Minnesota, Wisconsin, Iowa, Kansas, Texas, Missouri, Illinois, Indiana, Michigan, Ohio, New York and Vermont. In most cases the attacks were slight. However, in the Upper Mississippi Valley and eastward the disease was rather severe in some cases, especially in Wisconsin and Michigan where the plants were defoliated prematurely.

In Minnesota, Mariout and U. S. Wales barleys were reported by the Section of Plant Pathology of the College of Agriculture and Experiment Station as "the most severely attacked of twenty-one varieties grown on the University Farm".

Known seed treatments do not fully control the disease.

Spot blotch caused by Helminthosporium sativum P.K.&B.

Spot blotch of barley also was reported from a wider area in 1919 than the preceding year. It was reported from California, Washington, Idaho, Montana, North Dakota, Minnesota, Wisconsin, Nebraska, Iowa, Missouri, Texas, Tennessee, Illinois, Indiana, Ohio, Pennsylvania and Vermont. In no cases were losses said to be severe.

The ordinary seed treatments do not control the disease. It has been recently found at Wisconsin in cooperation with the Office of Cereal Investigations, (Jour. Agr. Res. 18:379,1920) that some form of dry heat seed treatment seems promising. However, this has not yet been perfected to the point of being applicable in practice except on very small lots of seed.

Rhynchosporium blight caused by Rhynchosporium secalis (Heins.) Davis.

The Rhynchosporium blight of barley was severe locally in central California, western Oregon, western Washington, and was reported as slight in Idaho, Montana, and Wisconsin.

Promising indications of disease resistance were reported by Johnson and Mackie (Phytopathology 10:54,1920). It was noted that certain selections from two barley varieties, Mariout and Tennessee Winter, showed rather striking evidences of resistance in comparison with a large number of other varieties grown along side in the same series of variety tests. Fortunately both of these barley varieties, Mariout and Tennessee Winter, are adapted agronomically to California conditions.

Anthracnose caused by Colletotrichum cereale Manns.

Anthracnose on barley was reported from but four states in 1919; namely, Minnesota, Tennessee, Texas and Wisconsin.

Ergot caused by *Claviceps purpurea* (Fr.) Tul.

Ergot on barley was reported in 1919 from North Dakota, Minnesota, Wisconsin, Iowa, Missouri, and Indiana, in all cases as rare or a trace. In Minnesota, in addition to being reported on common barley (*Hordeum vulgare*) from a number of counties, it was reported on six-row barley (*H. hexastichon*) from Ramsey County, and on two-row barley (*H. distichon*) from Ramsey and Stevens Counties.

Other diseases.

Bacterial blight of barley, caused by *Bacterium translucens* J. J. & R., was reported as having occurred to a limited extent in Idaho, Montana, Minnesota, Wisconsin, Iowa, Arkansas, and Ohio. In Arkansas W. R. Rosen reported the disease severe on barley in seedling stage.

Atanasoff and Johnson reported (Jour. Agr. Res. 18:386, 1920.) that the seed borne infection from this disease could be eliminated by severe dry heat treatment.

Powdery mildew of barley (*Erysiphe graminis* De C.) was reported as slight from Idaho, Montana, Minnesota, Wisconsin, Indiana, Pennsylvania, and Tennessee and no doubt occurred much more extensively.

Septoria sp. on barley was reported from Idaho, North and South Dakota. No injury reported.

A "foot rot", causal fungus not determined, was reported from western Washington by Heald and Dana.

Stripe rust on barley caused by *Puccinia glumarum* (Schm.) E. & H. was not reported from any state in 1919.

The so-called false stripe of barley, cause not known, was reported from North Dakota, Wisconsin, and Missouri.

Frost injury to barley was reported by C. W. Hungerford as common in Idaho in 1919, causing, on the whole, about 5% loss in that state. He states also that, "Heavy frosts when heads were emerging from boot killed part of spiklets in heads."

OATS

Smut caused by *Ustilago avenae* (Pers.) Jens. and *U. levis* (K. & S.) Mag.

The smuts of oats were reported from almost every state in the Union. No reports were received from a few states. No doubt these smuts occurred at least to some extent wherever the crop was grown. However, it was reported from a number of states that there was, on the whole, less smut in oats in 1919 than in previous years.

On the accompanying map is indicated the estimated percentages of loss in the various states from which reports were received. The estimated losses summarized in bushels are given in Plant Disease Bulletin, Supplement 12, 1920.

While these state averages are mostly comparatively low in different states, a number of fields with very high percentages of smut were observed during the course of the cereal disease survey. These are given in the following table:

Table 14. Highest percentages of smuts of oats in 1919 as reported by the cereal disease survey.

State	Highest percentage reported		State	Highest percentage reported	
	Covered smut	Loose smut		Covered smut	Loose smut
New York	48.	14.	Nebraska	6.	3.
Pennsylvania	16.	30.	Kansas	20.	20.
Maryland	0.	14.	Kentucky	0.	4.
Virginia	t.	35.	Tennessee	10.	25.
Georgia	2.	12.	Alabama	42.	20.
Ohio	24.	24.	Texas	24.	30.
Indiana	12.	24.	Oklahoma	10.	10.
Illinois	4.	50.	Arkansas	14.	15.
Wisconsin	5.	9.	Montana	40.	3.
Minnesota	30.	5.	Colorado	.7	3.6
Iowa	8.	24.	Idaho	60.	20.
Missouri	20.	26.	Washington	40.	12.
North Dakota	10.	0.	California	100.	0.

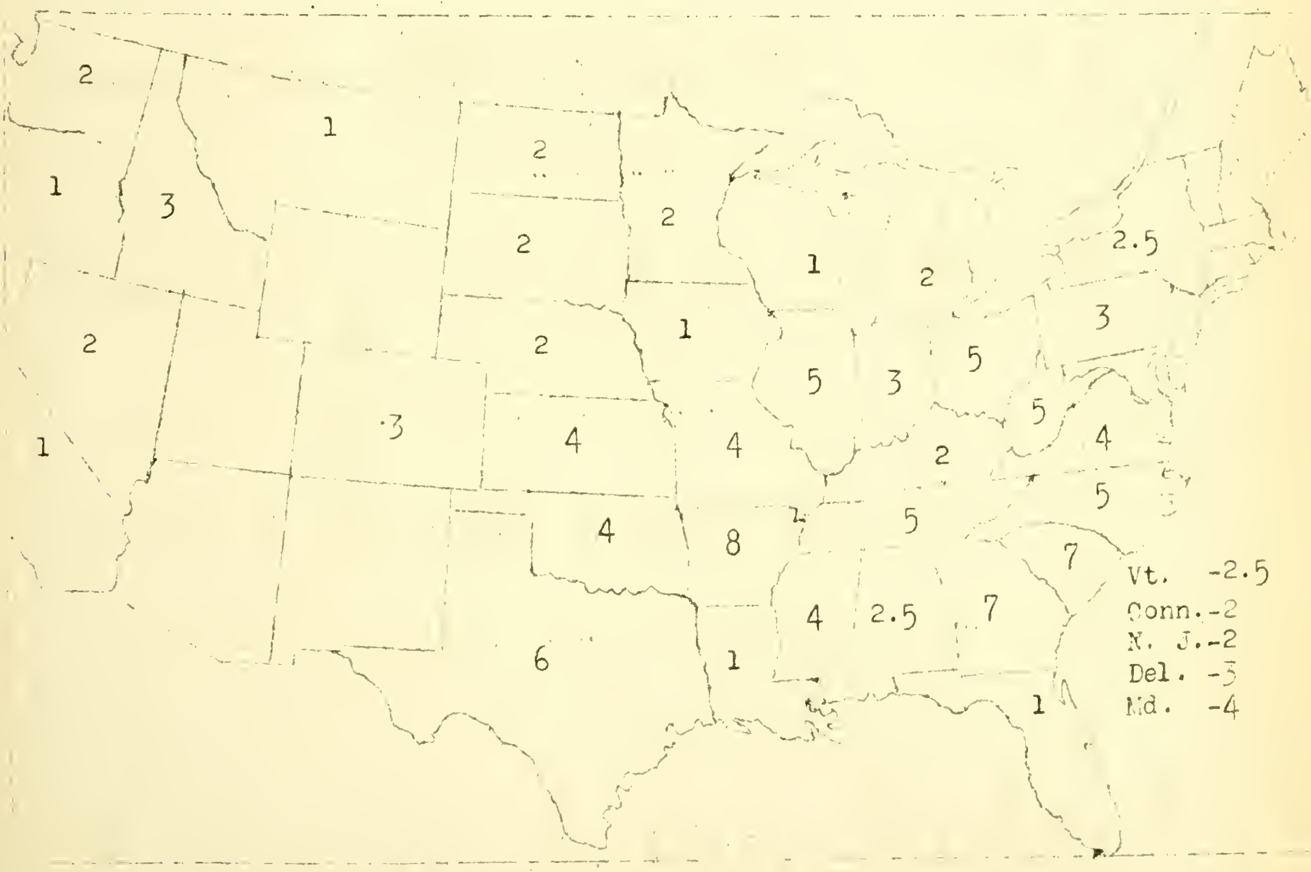


Fig. 16. Estimated percentage reduction in yield from smuts of oats, 1919.

Table 15. Extent and effectiveness of formaldehyde seed treatments for prevention of smuts of oats, according to collaborators and cereal disease survey.

State	Collaborators' estimates of percentage of farmers using:		Data from cereal disease survey				
			Number of fields			Percentage smut	
	Wet method	Dry method	Total No. surveyed	Untreated seed sown	Treated seed sown	Seed not treated	Seed treated
Vermont	20%	Very few					
New York			113	68	45	4.8	.8
Pennsylvania			122	93	29	3.5	.2
Maryland			4	4	0	7.5	0.
Virginia	Very few	Very few	5	5	0	10.8	0.
West Virginia	10%						
South Carolina	2%	1%					
Georgia			23	11	12	7.3	.5
Ohio	25%	10%	26	20	6	9.2	2.
Indiana			254	182	72	5.4	.4
Illinois			31	27	4	5.4	.5
Michigan	5%	50%					
Wisconsin			139	112	27	.9	.5
Minnesota	28%	Very few	280	232	48	3.1	.7
Iowa			78	65	13	.8	.1
Missouri	20%	Very few	101	75	26	6.5	.6
North Dakota			11	8	3	0.	0.
Nebraska			13	7	6	3.8	T.
Kansas	25%	25%	51	32	19	11.6	.9
Kentucky			14	13	1	.5	0.
Tennessee	10%	0%	38	36	2	3.9	T.
Alabama			113	99	14	3.	.4
Louisiana	Practically none						
Texas			176	153	24	7.2	1.7
Oklahoma			33	33	0	6.1	0.
Arkansas	5%	Very few	8	7	1	10.7	1.
Montana			60	47	13	.4	T.
Colorado	10%	0%	20	15	5	.7	.8
Nevada	25%	0%					
Idaho		0%	94	60	34	5.4	1.4
Washington	65%	0%	72	21	*51	5.7	1.2
California	Very few	0%	109	108	1	1.5	0.

* Both formaldehyde and copper sulphate seed treatments used.

No outstanding cases of varietal resistance were reported. Formaldehyde seed treatments were reported very generally effective and fairly commonly practiced in 1919 in certain states, in others less so. Both wet and dry methods were used.

Table 15, which is largely self-explanatory, gives data on extent and effectiveness of seed treatments as applied to oats for prevention of smuts.

As to the relative effectiveness of the dry and wet methods of formaldehyde seed treatment, collaborators were requested to report: "Results with dry formaldehyde (pint to pint) treatment for oats as compared with the ordinary sprinkling, 1-40 (1 pt. to 40 gal.) method."

The following reports were received. Other states either had no data or did not report.

Pennsylvania: "Dry formaldehyde method has largely supplemented the 'wet method' in treatment of oats." C. R. Orton.

Arkansas: "The dry formaldehyde method (1-1) of controlling oat smuts was found to be satisfactory, but not as complete a control as the 1-40 method. A few smutted heads appeared in the dry treated grain." Elliott.

Michigan: "Excellent." Coons.

Missouri: "Dry treatment with formaldehyde for oats is rarely used in this state." Maneval.

Kansas: "The dry formaldehyde treatments for oat smut have given equally satisfactory results when compared to the ordinary sprinkling method." Melchers.

Washington: "Not as satisfactory according to our Experiment Station experiments of 1918; better according to 1919 tests." Heald.

Vermont: "We recommend both, but the county agents and farmers are familiar with the wet method and Vermonters are slow to change." Gilbert.

Idaho: The following was reported by C. W. Hungerford on tests carried on at the Idaho Experiment Station with several methods of seed treatment for oat smut prevention. Three lots of smutted oats were used. The results from three of the treatments, namely; 1 pt. to 40 gal. wet method, 1 pt. to 10 gal. wet method, and 1 pt. to 1 pt. dry method, in comparison with results from untreated controls, are summarized in the following table:

Table 16. Summary of results of tests in Idaho in 1919 on comparative effectiveness for oat smut prevention of wet and dry methods of formaldehyde seed treatment.

Seed lots	Percentage of smut in crop			
	Untreated controls	1-40 wet method	1-10 wet method	1-1 dry method
A	12	0	0	1
B	3	0	0	0
C	2	0	0	0

South Carolina: The following was reported by J. L. Seal on tests carried out by a student under his direction at Clemson College. Two lots of seed were used: A = Red Rust Proof oats, smutted; B = Fulghum oats, trace of smut. Two seed treatments, 1 pt. to 40 gal. wet method and 1 pt. to 1 pt. dry method, were used. The results are summarized in the following table:

Table 17. Summary of results of tests in South Carolina in 1919 on wet and dry methods of formaldehyde seed treatment on oats.

Seed treatments	Germination percentages		Percentages of smut in crop	
	Seed lot A	Seed lot B	Seed lot A	Seed lot B
Controls, untreated	100.0	85.1	6.0	2.8
Formaldehyde, 1 to 1 dry method	71.3	66.3	0.0	0.0
" " " " " "	54.0	55.4	0.0	0.0
" " " " " "	60.8	56.7	0.4	0.0
Controls, untreated	97.3	82.4	9.2	5.4
Formaldehyde 1 to 40 wet method	66.3	56.7	0.2	0.0
" " " " " "	54.0	78.4	0.0	0.0
" " " " " "	83.8	79.7	0.0	0.0
Controls, untreated	82.4	93.2	7.6	4.8

Stem rust caused by Puccinia graminis Pers.

Stem rust of oats occurred over a wide range in 1919 as in previous years. In a number of states, notably Minnesota, the Dakotas, and Nebraska, the disease caused considerable losses while in many others the losses from this disease on oats was negligible. On the accompanying map are indicated the occurrence and estimated percentages of reduction in yield in the various states from which reports have been received. The estimated losses are summarized in bushels in Plant Disease Bulletin, Supplement 12, 1920.

While in general the percentages are low, it is well known that stem rust is a limiting factor in the successful culture of oats in southern California. Hence the figures on losses in California greatly underestimate the actual situation, for if the rust attacks were less severe there, or if suitable rust resistant varieties were available for culture, a much greater acreage of oats would undoubtedly be grown in that section.

A few years ago the writer (Johnson) learned of certain rather unusual indirect effects of these severe attacks of stem rust on oats in southern California upon certain phases of agricultural practice there. In inspecting barley for diseases south of San Diego, especially in the vicinity of Chula Vista, it was found that barley was grown there chiefly for hay. Upon inquiry it was learned that other more desirable grains, especially oats were not grown for hay because of the severity of stem rust attacks on those grains, while it was found by experience that barley rusted but very little. The writer's observations as to these points, especially as to oats and barley, tended to substantiate this. That is, the rather limited amount of volunteer oats found was unusually heavily attacked by stem rust, while barley was rusted comparatively little and only with the barley leaf rust, which did but little damage.

The chain of rather unusual indirect effects referred to above, that this condition had upon certain phases of agricultural practice, may be summed up briefly as follows: In the first place, horses, in general, are preferred to mules for use on the extensive lemon plantations in that section. Further, the common method of producing hay there for farm animals is by growing grains and cutting and curing same just before maturity. Oats thus handled makes good hay and is satisfactory for horses. But, as stated above, the growing of oats for this purpose had to be discontinued because of the unusually severe attacks of stem rust, and barley was substituted.

It was found that the awns on the barley used for hay irritated the mouths of the horses to the extent of making them so sore that the horses did not do well. On the other hand, it was found that mules were not bothered in this way by the barley hay. On account of this general situation the horses formerly owned on the large lemon ranch visited had been disposed of and mules substituted.

The stem rust of oats was reported as serious locally in northeastern Pennsylvania. Here the severe attacks were associated with aecial infections on the common barberry. Local outbreaks were also reported from Vermont Both in North and South Dakota the more severe attacks were in the eastern sections of those states.

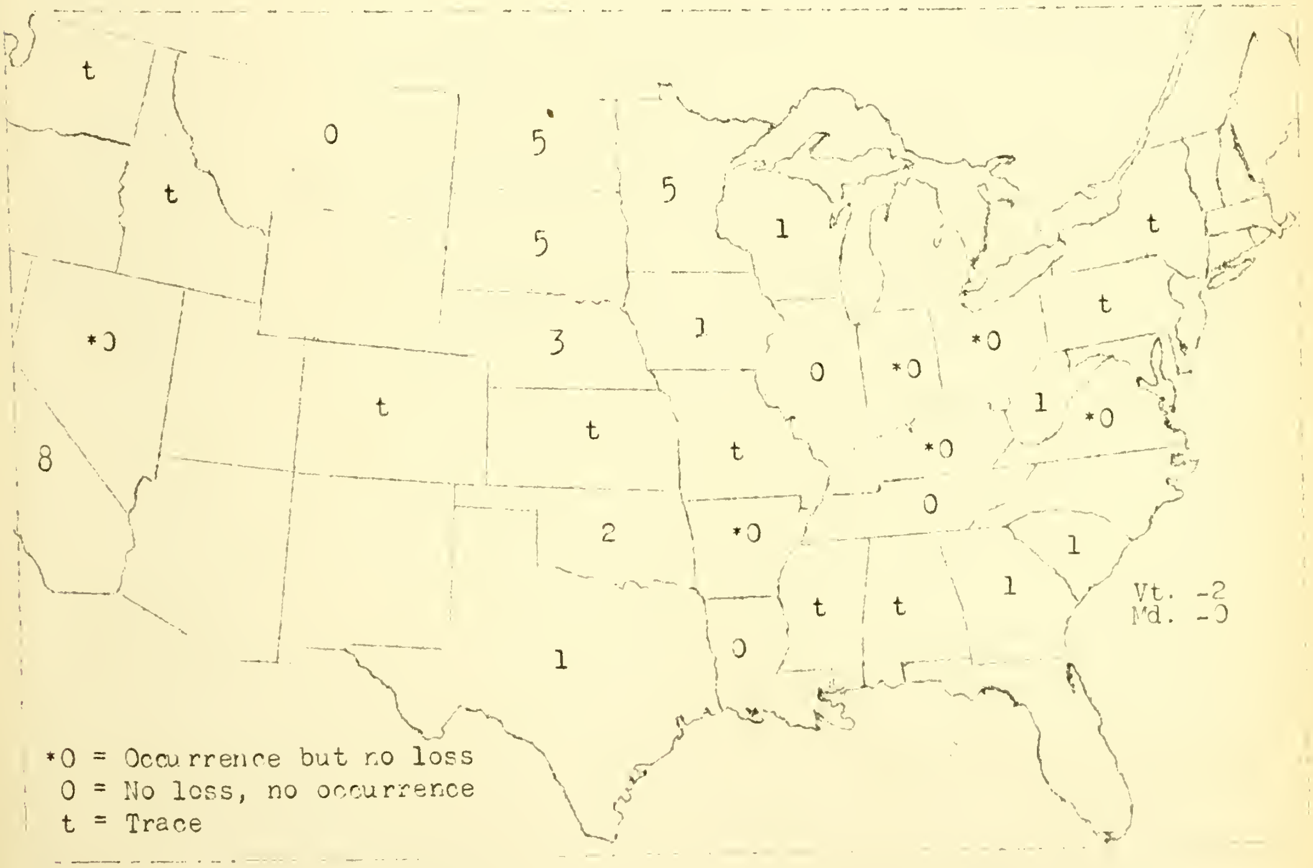


Fig. 17. Estimated percentage reduction in yield from stem rust of oats, 1919.

No outstanding cases of rust resistance were noted, although in Texas it was reported that the varieties Texas Rust Proof and Ferguson were somewhat less rusted than other varieties. Also from Oklahoma Texas Rust Proof was reported as not so badly rusted as other varieties. As with most other grains, it was noted that late varieties of oats tend to rust more heavily than the earlier varieties. It was noted, particularly in South Dakota and Wisconsin, that the variety Sixty Day ripened sufficiently early to escape the severe attacks of the rust. In Minnesota the oats varieties were listed in the following order as to relative susceptibility to rust, the least susceptible first: White Russian, Green Russian, Swedish Select, Silvermine, White. It was noted, however, that the estimated percentages of rust on these varieties were not very widely separated.

Crown rust caused by *Puccinia coronata* Cda.

Crown rust of oats occurred widely during 1919, as in previous years. On the accompanying map are indicated the observed geographic range and estimated percentages of reduction in yield where losses were reported. The estimated losses are summarized in bushels in Plant Disease Bulletin, Supplement 12, 1920. In general, the highest percentages of loss were relatively the greatest in the southern and southeastern states and in the northern Mississippi Valley. In the former general region winter oats are grown, and in the

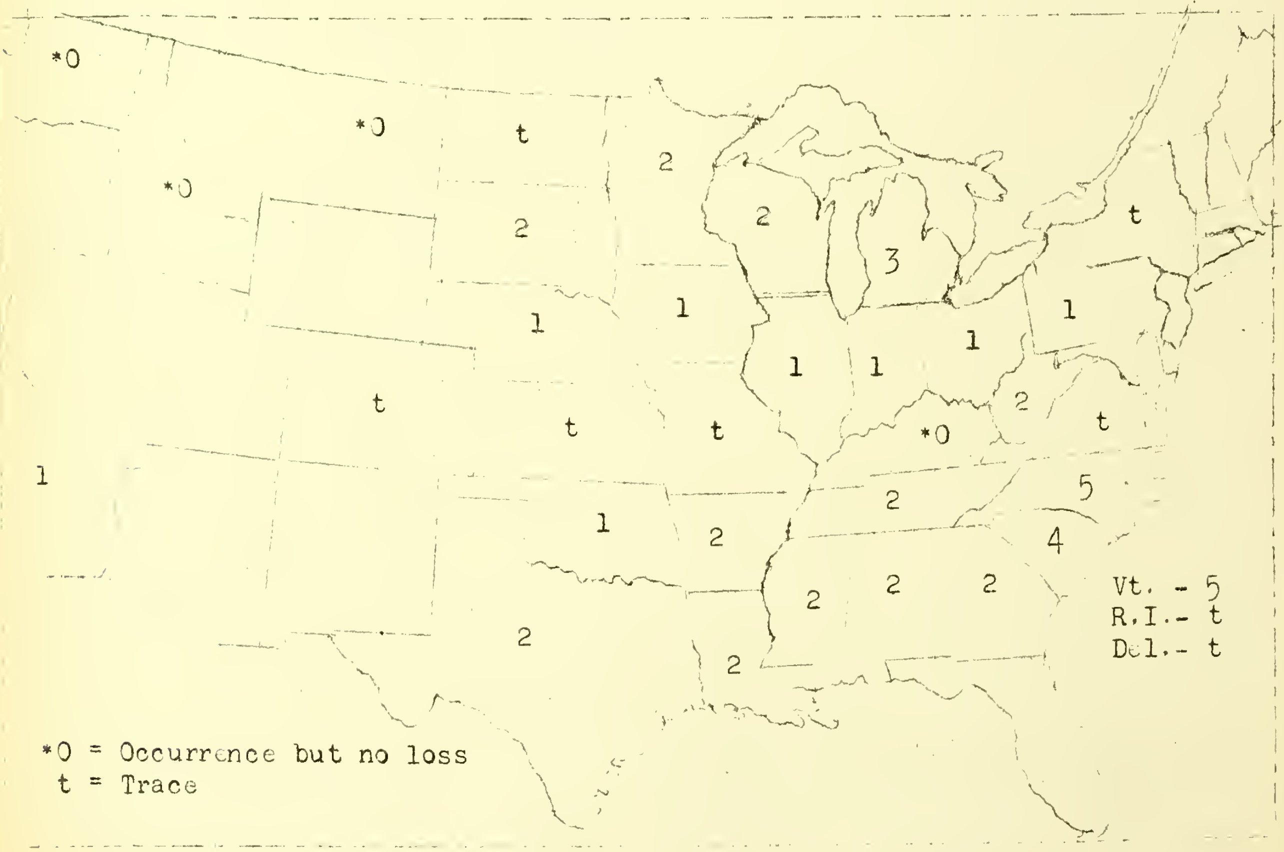


Fig. 18. Estimated percentage reduction in yield from crown rust of oats, 1919.

latter only spring oats are grown. The unusually open preceding winter and early spring made conditions unusually favorable for the rust development on oats in the southern and southeastern states in 1919, which no doubt accounts to a large extent for the losses there. In the northern Mississippi Valley the greatest losses occurred on late maturing varieties, which is usual. In the general region midway between, where losses from this rust are reported as being considerably less, the spring oats ripen earlier than farther north and tend to escape the later attacks from the rust. Furthermore, indications are that the buckthorn, which carries the aecial stage, is an important factor northward in starting epidemics of this rust. Definite cases of association between aecial infections on the buckthorn (Rhamnus cathartica) and heavy crown rust infections on oats were noted in Iowa, northern Illinois and southern Wisconsin; and it is suggested from Vermont that a similar condition may possibly obtain in that state also.

Infections were reported from South Carolina and Mississippi as early as April, from Tennessee May 15, from South Dakota June 24, Minnesota June 26, Wisconsin June, and Vermont July 15.

While no outstanding resistant varieties are reported, certain hybrids and varieties are reported as showing some promise in this direction. Peltier reported that in Alabama their Hybrid 615 rusted only 2%, and their T.R.P. No. 1020 also only 2%, while such varieties as Culbertson and Black oats No. 838, growing under similar conditions, rusted 65-100%. Melhus and Durrell reported from Iowa that Burt and Green Russian are proving somewhat resistant to this rust.

Scab (blight) of oats caused by Gibberella saubinettii (Mont.) Sacc.

Scab on oats was more general and more severe in 1919 than had ever been previously noted. Heretofore this disease on oats had been regarded as more or less of a curiosity.

In Illinois certain fields of oats were noted where the infection was very heavy, namely; more than 80% of the heads being affected and some of them entirely destroyed. This particular field had been in corn the preceding year.

In Iowa the disease was found general on oats, especially in Cherokee, Clay, and Kossuth Counties. In Scott County one field was noted with as much as 45% of the heads affected.

In Minnesota the disease was found at a number of points, especially in the southern parts of the state. In Murray County one field was noted where 65% of the heads were affected and in Nobles County a field with 25% was seen. In both of these cases it was noted that the preceding crop had been corn.

The disease was also noted in slight amounts in Wisconsin, Missouri, and Tennessee.

The estimated losses from this disease are comparatively small and not general. It is estimated that the yields in Minnesota and Illinois were reduced each approximately 1%. In the other states where the disease occurred the losses were but slight. These losses summarized in bushels are given in Plant Disease Bulletin, Supplement 12, 1920.

According to records in the files of the Office of Plant Disease Survey, the disease was apparently first reported by Pammel from Iowa in 1904 with the note that it was reported from two places in the state. In 1907 it was again reported from Iowa; in 1910 from Delaware; in 1915 from Minnesota and Ohio; in 1916 from Ohio; in 1918 from Ohio and South Dakota.

Anthracnose caused by Colletotrichum cereale Manns.

Anthracnose was reported as occurring less commonly on oats than on wheat and rye in 1919. The disease was reported from Alabama, Minnesota, Missouri, Ohio, Virginia, and Wisconsin. It was reported by Freda Detmers as, "Very abundant in vicinity of Wooster, Wayne County, Ohio." She also reported that the formaldehyde wet method (1 pint to 40 gallons) "kills spores in acervuli on flowering glumes and those which may adhere to grain."

Other diseases.

Halo leaf blight of oats caused by Pseudomonas avenae Manns was reported from practically all of the oats growing states east of the 105th meridian and also from Idaho. It was reported as "Severe on oats seedlings" in Arkansas; unusually severe in Delaware, causing marked losses; "General but not destructive" in Iowa; "Not common" in Idaho. From Kansas, Melchers reported as follows: "Recorded from a few fields early in the season. Considerable excitement occurred in the southern part of the state in the early season due to some of this disease, but the plants soon outgrew the trouble."

Atanasoff and Johnson reported (Jour. Agr. Res. 18:386, 1920) perfect control of the seed borne infection of this disease by dry heat seed treatment.

Brown leaf blight of oats caused by Helminthosporium avenae-sativae (B. & C.) Lind. was reported from Washington, Idaho, Montana, Nebraska, Minnesota, Wisconsin, Indiana, New York, and West Virginia in 1919. Injury slight.

Powdery mildew on oats caused by Erysiphe graminis De C. was reported from California, Washington, Idaho, Wisconsin, and Ohio; practically all cases slight, except on Pacific Coast where some severe infections were noted.

Ergot caused by Claviceps purpurea (Fr.) Tul. was reported on oats from North Dakota and Minnesota.

Septoria sp. was reported on oats from Minnesota, Wisconsin, Missouri, and Kentucky as slight.

Foot rot of oats, fungus undetermined, was reported from western Washington by Heald and Dana.

Alternaria sp. was reported on oats from Missouri but the character of the attack was not stated.

Oats blast (sterility), cause not determined, was reported very generally from practically all of the oats growing sections east of the 105th meridian and from California, Washington, Idaho, and Montana.

"Red leaf" of oats, cause not definitely determined, was reported from Delaware, Pennsylvania, Michigan, Missouri, Illinois, and Washington. Heald states that reddening of the leaves and stunted, poorly filled panicles are the result of frost injury in Washington.

Frost injury to oats at heading time was reported from Idaho and Washington.

CORN

Smut caused by Ustilago zeae (Beck.) Ung.

Corn smut probably occurred in every state in the Union although it was rather rare west of the Rocky Mountains, perhaps largely on account of the scarcity of corn in that region.

In general the disease was more severe than in 1918. The states of New Jersey, Maryland, West Virginia, Ohio, Indiana, Michigan, Wisconsin, and Minnesota reported definitely that it was worse than usual. In Michigan it was said to be the chief subject of letters from farmers to the Department of Botany, and field agents of the U. S. Bureau of Crop Estimates reported an excess of smut in that state. The disease was said to be somewhat less than usual in the extreme northern and southern states of Vermont and Louisiana. The remaining states that reported noted it as present in about the usual amounts.

The percentage losses by states are indicated on the accompanying map. The following table also gives one an idea of the abundance of the disease in different states:

Table 18. Percentage affected corn plants according to collaborators.

State	Percentage affected plants	Maximum percentage reported
Pennsylvania	1-10 (Average 4)	33
Delaware	2-5	Over 40 in one field.
Maryland	---	44% in one field by count, (10% on ears).
North Carolina	10	---
South Carolina	15-20	---
Indiana	8	---
Michigan	---	25
Wisconsin	t-12	---
Minnesota	15-25 in Sherburne Co.	25
South Dakota	5	---
Iowa	7 on field corn, 15 on sweet corn	
Oklahoma	8	---
Colorado	10-25	25 or more

In Michigan counts in 10 fields near East Lansing showed smut on some part of the stalks to the extent of 10-12%. In Colorado, where 5% actual loss is estimated, it was said to be "the worst disease of the crop".

That this disease is influenced more or less by environmental conditions is indicated by the following quotations:

> Wisconsin: "More in the southern than northern sections of state. More on light sandy soils than on heavy soils." R. E. Vaughan.

> Kansas: "Very prevalent especially in the western part of the corn belt. The drier the region, the more corn smut." L. E. Melchers.

The following quotation from H. L. Bolley in North Dakota suggests the possibility of seed transmission; "The amount present depends upon individual fields where certain types of seed are planted. There is some indication that this disease is transmitted with the seed, probably internally."

Sweet corn was almost universally reported as more affected than field corn; and pop corn, which was reported smutted in Indiana and Georgia, was even more susceptible than sweet corn in the latter state. Field and pop corn were observed by J. A. McClintock in Georgia, growing in adjoining rows with much more smut on the varieties of pop corn than on those of field corn.

In 1918 the pop corn varieties White Rice and Golden Queen were especially affected in Georgia. In Tennessee early corn was much more smutted than late corn. Very little smut was present in the late corn according to Essary.

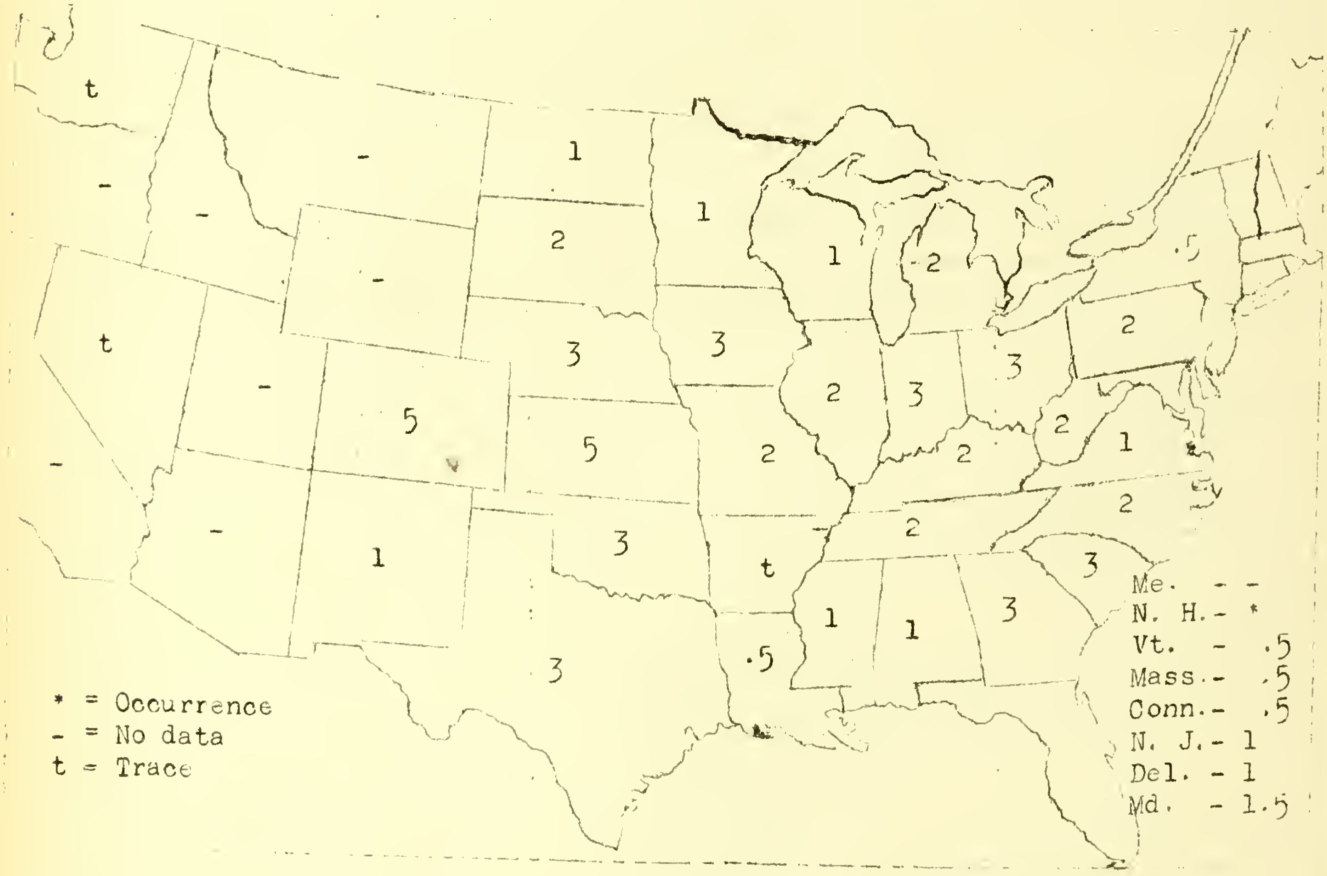


Fig. 19. Estimated percentage reduction in yield from smut of corn, 1919.

Root, stalk and ear rots caused by Gibberella spp. and Fusarium spp.

Some, or all of the manifestations of these complicated troubles on corn were observed in 1919 in practically all states east of the 100th meridian. No reports were received, however, from northern New England. In fact the occurrence of these troubles in the entire northern tier of states seems to have been much more limited than farther south. The only indication of the presence of this trouble in the states west of the north and south line just mentioned, is the report of H. P. Barss from Oregon that "Fusarium is common in corn fields, but whether serious or not requires further study."

Unitl the last few years smut has been regarded as the only important corn disease in the United States; but more recently these root, stalk and ear rots have been found to be causing unusually large losses that were heretofore ascribed to other factors. It is evident that, as a group, these troubles cause far greater losses than corn smut and all the other corn diseases combined. The percentages of estimated loss for 1919, given on the accompanying map, are probably very conservative when all the various results of the disease, such as missing hills, stunted plants, barren stalks, nubbins, down stalks, ear rot, etc. are considered. Apparently the highest percentages of loss occurred in Tennessee, Kentucky and the surrounding states. Regarding the losses in Tennessee, S. H. Essary reported as follows:

> "This was by far the most destructive disease in the state this season. Very few fields were found without the infection. The estimates of losses are probably far too small. It was noted that where corn was grown continuously the disease was very serious, although it is found even in new fields. Some fields showed as high as 98% infection. It is believed that the disease is gaining."

Two fields were noted by C. H. Philpott in Missouri, with 75% and 60% reduction in yeilds. In both fields practically every plant was affected with root rot and there were many "down" stalks.

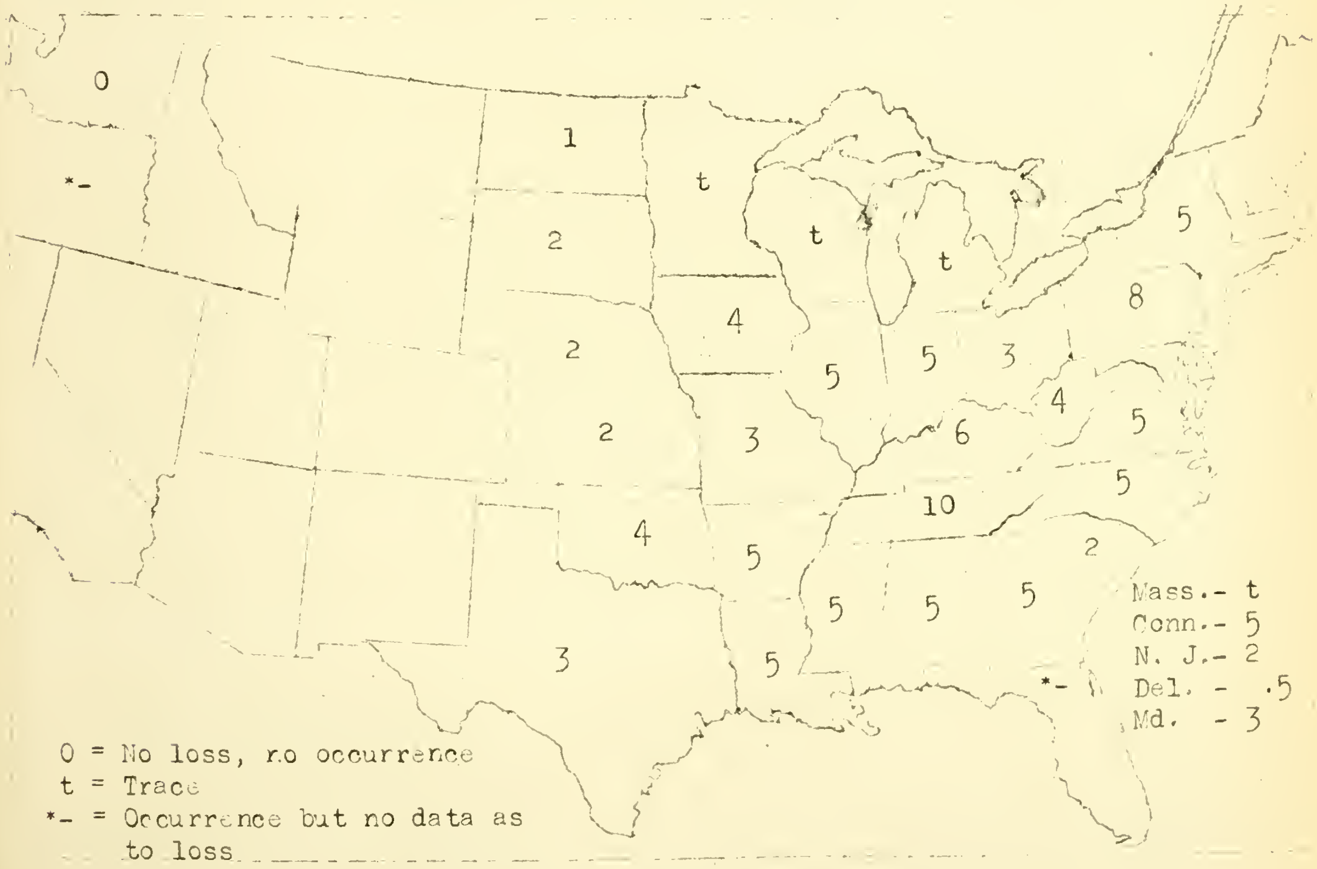


Fig. 20. Estimated percentage reduction in yield from root, stalk, and ear rots of corn, 1919.

On the Experiment Station grounds at Lexington, Kentucky, many barren stalks which broke over readily at the end of the season, occurred according to Valleau. He says further, "During June certain fields promised no crop but recovered and gave nearly normal yeilds. One field near Lexington was a total loss from root rot. Other fields on same farm in same rotation gave normal yield. Varieties not known. Many of the weak stalks seem to be due to nodal infections rather than to a systemic infection starting at the roots."

Very little on varietal differences was reported for 1919. The ear rot form of the disease was found in Minnesota on sweet corn and on the field varieties King Philip, Squaw Flint, Longfellow; and one of the root rot cases in Missouri occurred on St. Charles Yellow.

The bearing of certain of these troubles on rotation practices, particularly as bearing on wheat scab, has already been discussed under wheat scab (page 43).

Control measures for these troubles are not simple, nor are they as yet fully worked out. However, important beginnings have been made. The work of the Office of Cereal Investigations, carried on in cooperation with the Agricultural Experiment Stations of Indiana, Illinois, Iowa, and Wisconsin and with the Funk Bros. Seed Company, Bloomington, Ill., is indicating that the most careful attention to seed corn selections, both in the field and in the germinator, with the diseases in mind, together with the best agronomic practices in corn growing, will go a long way in greatly reducing the losses from these important troubles both on field and sweet corn.

Brown spot caused by Physoderma zeae-maydis Shaw.

Brown spot (Physoderma) of corn occurred in 1919 over about the same area from which it had been reported in previous years. In general the disease was reported slightly more severe than in the preceding year but less severe than in 1917. The disease was definitely reported by collaborators and W. H. Tisdale, Office of Cereal Investigations, from Kansas, Oklahoma, Missouri, Arkansas, Louisiana, Illinois, Indiana, Kentucky, Tennessee, Mississippi, Alabama, Florida, Georgia, South Carolina, North Carolina, Virginia, and Maryland. The distribution and estimated percentages of reduction in yield are indicated on the accompanying map. The estimated losses summarized in bushels are given in Plant Disease Survey, Supplement 12, 1920.

The following report from Alabama is of especial interest. "Considerable damage is done in the southern part of the state and some damage in the northern part. Some fields were almost lost in the southern section. Severity there is attributable to excess rain. County agents report the disease abundant throughout the state." Peltier.

W. H. Tisdale reported the disease in slight amounts from Bloomington, Ill. and La Fayette, Ind. These reports are of especial interest in that these places represent the most northern points in those states from which the disease has ever been reported. Tisdale's report of the disease from Bloomington, Ill. is of especial interest also in that the place where the disease was found was where corn from Mississippi had been planted the preceding year. It is suspected that the spores of the parasite may have been introduced with the Mississippi seed corn in 1918 and buried, as that corn was planted, and turned to the surface and ready for action as the land was plowed for the 1919 crop. This seems not unlikely since Tisdale reports that he has secured normal germination of the Physoderma spores after two years storage under field conditions on the farm of Clemson College, South Carolina, both from material kept on the surface of the soil and from similar material buried three inches in the soil.

No varietal resistance was reported.

While long rotations and general clean up measures seem to be the most promising methods of control, it is not yet known how long the parasite is capable of remaining viable in the soil, or how resistant the spores may prove to be to various exposures.

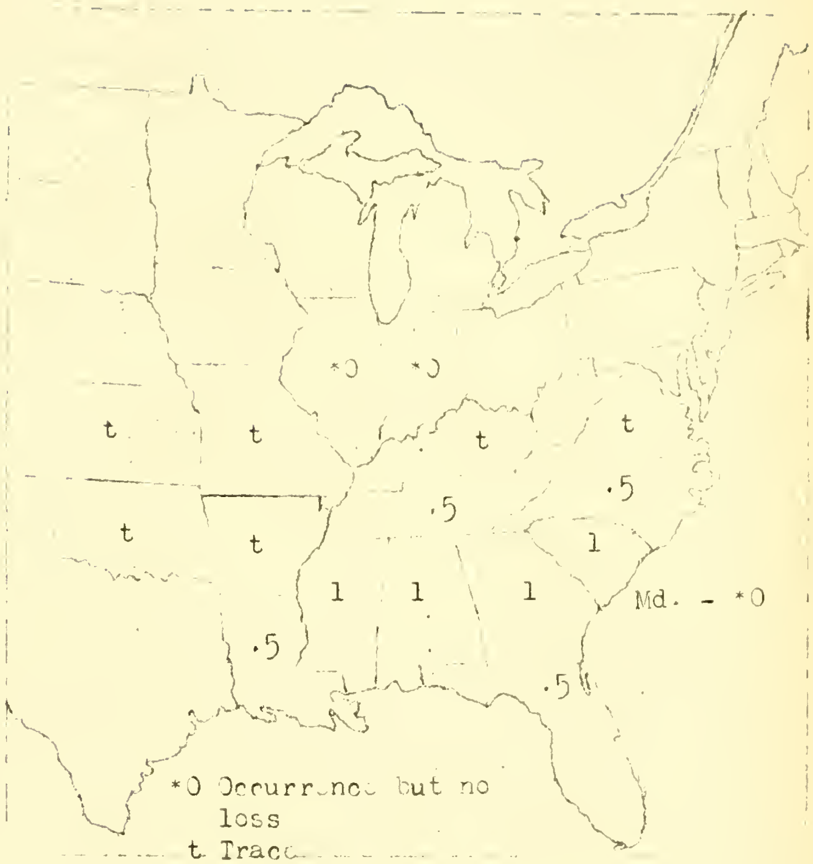


Fig. 21. Estimated percentage reduction in yield from brown spot of corn, 1919.

Bacterial wilt caused by Aplanobacter stewartii (Sm.) McC.

Observations of this disease were made in New York (Oneida County), Virginia, Kentucky, Tennessee, Georgia, Ohio, Indiana, Illinois, Iowa, North Dakota (Cass County), and Kansas. Although particularly a disease of sweet corn, it was not entirely confined to that crop as field corn, both yellow and white dent types, were found affected in some states.

Practically the only available figures, showing abundance of the disease, are those obtained by F. V. Rand, Bureau of Plant Industry. These are given in Table 19.

At the Kentucky Experiment Station the loss of some sweet corn varieties in trial plots was total on account of this disease.

The variety Golden Bantam was listed as especially susceptible in Virginia, Kentucky, and Indiana. At the Kentucky Station the low growing varieties, such as Golden Bantam and Peek-o-Day, were a total loss, while larger varieties were less susceptible according to Valleau.

Table 19. Percentages of bacterial wilt in individual fields observed by F. V. Rand, August to September 10, 1919.

State	Sweet corn		Field corn	
	Variety	Percentages affected plants	Kind of corn	Percentages affected plants.
Ohio	Stowells Evergreen	t,t,t,t,t,t,5,15 1,t,t,t,t,5	Yellow dent	1,t,t,t,
	Apparently Stowells Evergreen	t,5,30 (Probably more as stand was poor) 15,10, t,t,t,5		
	Late Mammoth	t		
	Early Minnesota	10		
	Late sweet corn - variety unknown	5,t,t		
Indiana	Golden Bantam - mixed with white variety	30		
Tennessee	----	t (in several fields),5	White dent	t
Georgia	----	-----	White dent	t

Rust caused by Puccinia sorghi Schw.

Corn rust was reported as having occurred in about the usual amounts in the central and eastern states in 1919. In Indiana the disease was reported as somewhat less prevalent than usual; in Massachusetts it was both more prevalent and more severe, especially on sweet corn; and in Minnesota and Oklahoma it was reported as more general than in preceding years. It was first noticed in July in Wisconsin, Minnesota, Oklahoma, and Arkansas.

The reports of this disease from New Mexico (abundant) and Colorado (slight) were the first received by the Survey from either or these states, or from any state west of the corn belt, except California, where it was reported as slight locally in 1910.

The losses were reported as negligible, except in Louisiana, where practically all of the crop was injured and slight losses were sustained.

Both field and sweet corn, also pop corn in Minnesota, were attacked. Sweet corn was reported especially susceptible in Indiana and Massachusetts. In the latter state the variety Golden Bantam was said to be particularly susceptible.

Head smut caused by Sphacelotheca reiliana (Kühn) Clinton.

This rare and interesting smut of corn was collected by G. L. Zundel and B. F. Dana in two separate localities near Pullman, Washington in September. This is the first report of this disease of corn from Washington and is one of the first to be received by the Survey from any part of the United States. Melchers has stated that it occurs on corn in Kansas, but is not common, and Clinton (North American Flora, 7:30, 1906) has received collections from that state and from Ohio.

Leaf blight caused by Helminthosporium inconspicuum C. and Ell.

Collections of this disease were made in New Jersey, Kentucky, South Carolina, Ohio, and Minnesota. In South Carolina it was said to be common and occurred widely over the state.

Other diseases.

Ear rot caused by Diplodia sp., was reported from Delaware (not prevalent), Pennsylvania (slight), Ohio, Florida (local, as high as 10% in some cases), Louisiana (common, considerable loss), and Arkansas (common, 2% injury, considerable loss). In Pennsylvania C. R. Orton finds it developing on kernels in the laboratory that are being tested for presence of Fusarium. Some ear rot was found in Pennsylvania on the varieties Reid's Yellow Dent, College White Cap, and Millinger's Yellow Dent.

Purple sheathspot caused by various fungi in connection with pollen grains, aphis secretions, etc., (See Phytopath. 10:54, 1920) was said to be very common in Iowa by Melhus and Durrell.

Bacterial root rot, organism not determined, was reported from three counties in Arkansas by H. R. Rosen (Ark. Agr. Exp. Sta. Bul. 162:1-7, 1919). In two sections it was doing considerable damage.

A bacterial leaf spot was said to be general in Iowa, injuring about 1% of the plants but causing practically no damage. A similar disease occurred on sweet corn in Idaho in home gardens in Latah County; and a bacterial trouble was reported from Kansas by L. E. Melchers as follows: "In June and July a bacterial disease of corn was very conspicuous on the sheaths and the stem below the tassel. It seemed to be closely correlated with the large amount of aphids present. These, no doubt, figured in its spread."

Stem rot caused by Pythium de Baryanum Hesse, was reported by Sherbakoff as locally very severe in Florida. Flat cultivation was said to be helpful in control in that state. A trouble of a similar nature was also reported by G. P. Clinton in Connecticut. He stated that oospores, apparently those of a Pythium sp., were found at the base of the stalks.

Anthracnose of corn, a new disease, caused by an undetermined species of Colletotrichum, was found by G. P. Clinton near New Haven, Connecticut, July 8. It was said to be rather inconspicuous on the leaves and not causing much injury.

Cob rot, caused by Coniosporium sp., was reported from Ohio.

"Albino" corn, the leaves of which were striped with yellow, was collected in Connecticut by G. P. Clinton.

RICE

Blast caused by Piricularia oryzae Br. & Cav.

Blast ("rotten-neck") of rice was reported as prevalent throughout the southern rice growing sections. It is possibly the most important disease of rice. It was definitely reported either by collaborators or by W. H. Tisdale, Office of Cereal Investigations, from Arkansas, Texas, Louisiana, Alabama, Florida, and South Carolina. In an individual field in Florida observed by Tisdale the disease was found to be unusually severe, 100% of the plants being found infected, which resulted in about 50% loss. In Arkansas, Texas, and Louisiana, where most of the rice is grown in this general section, the disease, while usually present and causing slight damage, was not serious except in individual fields. The disease was not found in California. No practicable control measures are known.

Straight head (cause not known).

The so-called "straight head" (blight) of rice was found by W. H. Tisdale to be rather general throughout the rice growing sections of the south. It was definitely reported from Texas, Arkansas, Alabama, and South Carolina. It is one of the most important diseases of rice. In individual fields in the Mississippi Valley in Louisiana losses were reported as high as 50 to 90%. In southwestern Louisiana and eastern Texas, however, the disease is much less abundant. No control measures are known.

Smut caused by Tilletia horrida Tak.

Smut of rice was found by W. H. Tisdale to occur to a slight extent in the variety Honduras in Louisiana. No doubt it occurred more generally but was overlooked because it is not noticeable by general observations. The rice glumes must be broken open before the smut can be observed.

Green smut caused by *Ustilaginoidea virens* (Cke.) Tak.

Green smut of rice occurred to a very limited extent in Louisiana in 1919. During the entire season only a few diseased kernels were observed by W. H. Tisdale at Crowley, Louisiana. Not otherwise reported.

"Black speck" caused by *Sclerotium* sp.

The so-called "Black speck" of rice was found by W. H. Tisdale to occur on the leaves of the varieties Honduras and Blue Rose in Louisiana and Texas. Damage apparently very slight.

FLAX

Wilt caused by *Fusarium lini* Bolley.

Flax wilt was reported from North and South Dakota, Minnesota, and Wisconsin (only a trace) in 1919. The disease was unusually severe in North and South Dakota and Minnesota wherever non-resistant varieties of flax were by chance sown on infested land. H. L. Bolley reported as follows from North Dakota:

> "Wilt has been remarkably destructive this year on a wide range of territory, on all non-resistant flax which chanced to be planted upon wilt-sick soil. It proved to be extremely destructive where the flax was young during the very hot period of July. It never was more destructive in the vicinity of Fargo than it was during July of this year. Many other features have transpired to make wilt appear more destructive, namely; the abundance of crickets, grasshoppers, and other insects. These helped spread the disease under dry weather conditions."

Manley Champlin reported that in South Dakota select Russian flax was a total failure on land cropped to flax one, two, and four years previously. Where flax was sown on non-infested land the losses from wilt were negligible. In one case near Brookings, South Dakota, Champlin reports 50% loss from wilt.

As to wilt resistant varieties, N. D. R. 114 was reported the most resistant. In some cases N. D. R. 52 was also successful. H. L. Bolley made a special report as follows:

> "The variety known as N. D. R. 114 flax has proved strongly re-resistant, much more so than any other variety. There are many good crops of this variety in the Red River Valley this year, but even this variety came through much better in cases where it was planted early."

Canker (non-parasitic).

Flax canker was reported from North and South Dakota and Idaho in 1919. It no doubt occurred in Montana also as in previous years, although no definite reports were received. As to severity of the disease in 1919 but little definite information is at hand. In the Experiment Station plots at Mandan, North Dakota, however, the disease produced losses ranging from 2 to 50%. The greatest losses resulted in the plots where the soil was least shaded by crops and weeds. H. L. Bolley reported that the disease was "rather destructive in the early part of the season on certain new lands of the western portion of the state (North Dakota)."

As to the cause, experiments carried on by the Office of Cereal Investigations in cooperation with the North Dakota Experiment Station indicate that high temperatures at the ground-line when the flax plants are about one or four inches high, produce the typical canker regardless of fungi. A preliminary report on this work has already been made by C. S. Reddy and W. E. Brentzel. (Phytopath. 10: 66-67, 1920.) From investigations, indications are that a species of Colletotrichum may produce a special seedling blight and possibly may also attack stems to some extent, but typical canker is not produced by it.

As yet there are no indications of differences in varietal susceptibility. Control measures, as well as other phases of the problem, are being investigated by the Office of Cereal Investigations in cooperation with the North Dakota Experiment Station.

H. L. Bolley reported that "this disease seems to be more associated with new lands than with old, worked lands. It is always markedly more destructive in dry weather than in wet weather."

Rust caused by Melampsora lini (Pers.) Desm.

Flax rust was reported only from North Dakota and Minnesota in 1919. In North Dakota it was definitely observed at Mandan and Fargo: particularly severe at Fargo. In Minnesota it was definitely reported from Polk to St. Louis Counties.

While in general the losses from flax rust were slight, yet in certain localities the crop was severely injured. In these localities the injury ranged from a trace to 25%.

No differences in varietal susceptibility were reported.

As for control measures, avoiding continuous flax culture and sanitation by early sowing seem to be the most advisable.

SORGHUM

Covered kernel smut caused by Sphacelotheca sorghi (Link) Clinton.

This smut was reported on sorghum from Nebraska, (Kearney County), Missouri (Boone County), Arkansas (trace), Oklahoma (4 reports averaging 10%), Texas (2% loss), Minnesota (St. Louis County, Sept. 20), Washington (Douglas County, May 16).

Loose kernel smut caused by Sphacelotheca cruenta (Kuhn) Potter.

This smut was said to be present in Arkansas, troublesome in some regions in New Mexico, and abundant in Texas.

Head smut caused by *Sphacelotheca reiliana* (Kuhn) Clinton.

Head smut was reported from Tennessee, Arkansas, Kansas, Oklahoma, Texas, and New Mexico. In all states only slight amounts were reported.

Rust caused by *Puccinia* sp.

Reported from several places in Oklahoma. It was said to be uncommon, however.

Bacterial blight caused by *Bacillus sorghi* Burr.

This blight occurred in Iowa (common throughout the season, first reported June 19), Arkansas (general and severe, reported in June), and New Mexico (some damage, from 2-3% in some sections of the state).

FORAGE CROPS

A. LEGUMES.

ALFALFA (*Medicaco sativa*)

Leaf spot caused by *Pseudopeziza medicaginis* (Lib.) Sacc.

As usual this disease occurred widely over the country. It was reported from 21 states and was said to be generally distributed within most of them. The losses on the late cuttings in Delaware ran as high as 35% in some fields. West Virginia reported a state loss of 10%, South Carolina 1%, Georgia 5%, Colorado 1-2%, and Idaho 2%.

In Delaware and Iowa it was said to be more severe on the late than on the early cuttings. In Wisconsin the reverse seems to be true. The dates when the disease was first noted by collaborators are as follows:

April	South Carolina
April	New Mexico
May 26	Pennsylvania
May 28	Indiana
May 30	Colorado
May 30	Missouri
June 1	Georgia
June 2	Minnesota
July 16	Ohio
August 16	Washington
Sept. 15	Vermont

No varietal differences nor control measures were reported.

Yellow leaf blotch caused by *Pyrenopeziza medicaginis* Fckl.

Reported from South Carolina (common in mountainous section, causing some loss reported in May), Georgia (0-50% injury June 1), Kansas (common locally on first and second crops, causing 15% loss in some instances, Idaho (general, 15% injury, about 2% loss), and Washington (Whitman and Klickitat Counties).

Anthracnose caused by Colletotrichum trifolii Bain.

Reported from Delaware, Ohio, South Carolina, Georgia, Oklahoma, and New Mexico. The only state reporting any particular damage was Georgia where as high as 25% injury occurred in some cases.

Root rots caused by Rhizoctonia spp.

Isolated cases of a root rot caused by a Rhizoctonia were noted by T. F. Manns in Delaware, and the violet root rot caused by Rhizoctonia crocorum (Pers.) De C. (R. violacea Tul.) was reported by Fromme from Rockingham County, Virginia, where 5% of the plants in one field were attacked; and from Kansas, where Melchers reported it common in various parts of the state, mostly in the older fields.

A resumé of past survey reports is of interest in connection with this summary. In 1906 and 1907 violet root rot was reported by Heald from points in east central Nebraska, where it was occurring in spots in numerous alfalfa fields. In 1914 it was reported to the Survey from Scott County, Iowa; Ford, Jefferson, Leavenworth, Butler, and Franklin Counties, Kansas; Botetourt County, Virginia (first occurrence in the East), and Washington County, Mississippi. In 1915 it was reported by J. C. Arthur from St. Joseph County in northern Indiana, and in 1917 by H. S. Jackson from LaPorte County in the same state. Since 1914 the disease has been reported practically every year from the Iowa, Nebraska, Kansas group.

Downy mildew caused by Peronospora trifoliorum De Bary.

No very serious losses from this disease were reported in 1919 although occurrences were noted in Pennsylvania, South Carolina, Iowa, Kansas, Colorado, Idaho, New Mexico, and Washington. J. G. Leach in Colorado reported 10-15% crop injury with 1-2% loss, and C. W. Hungerford in Idaho reported 10% crop injury with about 1% loss for the state. In Kansas the first crop was injured rather than the others. The disease was reported April 10 in New Mexico, May 26 in Pennsylvania, and May 30 in Iowa.

Root rot caused by Sclerotinia trifoliorum Erik.

Reported from Virginia (common), South Carolina (local in northwest), and Washington (less than usual). It was first noticed April 1 in Virginia, and May 15 in Washington.

Bacterial blight caused by Bacterium medicaginis Sackett.

This disease was reported from the West as follows: Colorado (25-50% injury and 1-2% loss. First reported June 29), Idaho (general in southern Idaho, 5% injury, slight loss), Washington (weather not favorable for disease. First report May 14).

Root rot caused by Ozonium omnivorum Shear.

This rather limited trouble was reported only from Texas and Oklahoma. In Texas it was very prevalent in the eastern part of the state where it was estimated that about 40% loss reports were received from southern Oklahoma. The Hairy Peruvian variety was reported by Taubenhaus as showing slight resistance in Texas.

Other diseases.

Rust caused by Uromyces medicaginis Pass., was reported from Louisiana (common), Texas (unimportant), and Nebraska.

Leaf spot caused by Cercospora medicaginis reported from Denton, Dallas, and Kaufman Counties, Texas, causing a loss of about 1%.

Root knot caused by Heterodera radicicola (Greef.) Mull. was reported as causing about 1/2% loss in Texas. Hairy Peruvian showed some resistance.

Dodder (Cuscuta spp.). Reported from Texas and Washington.

A stem disease said to be caused by Diplodina medicaginis was reported by C. R. Orton from Halifax, Pennsylvania; on May 1 a 9-acre field showed 50% affected plants and the loss was estimated at 5%. The field was well fertilized and not in need of lime.

Stem spot, said to be caused by Ascochyta imperfecta, was reported from New Mexico by L. H. Leonian as follows: "Severe, causing 2% loss. First appeared early in April. First and last cuttings affected more than the others. Discoloration due to this disease reduces the price of alfalfa hay. No apparent weakening of the infected plants seen."

Stem disease, caused by Phoma sp., was reported by L. E. Melchers from Kansas as follows: "This was reported from different sections of the state, having been present more or less since 1915. It produces blackened lesions on the stems which in severe cases may cause them to crack."

Root rot, caused by Fusarium sp., was reported by Leonian from four counties in New Mexico. Two per cent loss was estimated for the state.

White leaf spot of unknown cause occurred fairly commonly in Idaho according to C. W. Hungerford.

Yellowing of alfalfa (non-parasitic) was noted in Lee County, Illinois; parts of Tennessee (severe locally May 26); Washington (slight, July 31); and a chlorotic condition, non-parasitic in nature, was rather common in southern Idaho, according to Hungerford, and caused slight loss.

Frost injury occurred to slight extent in Ohio and Washington according to the collaborators of those states.

CLOVER (Trifolium spp.)

Leaf spot caused by Pseudopeziza trifolii (Biv.-Bern.) Fckl.

This clover disease was reported as occurring less widely than the similar leaf spot of alfalfa. During 1919 it was reported on red clover from

Delaware, West Virginia, Ohio, Indiana, Iowa, Minnesota, and Washington. In most of these instances it was said to be of only slight importance but in West Virginia it injured a high percentage of the crop and was estimated as causing nearly 5% loss in that state. In parts of Ohio and Iowa it also did considerable damage.

Anthracnose caused by *Colletotrichum trifolii* Bain.

Anthracnose occurred on bur clover and on *Medicago arabica* in Louisiana where it was noticed doing considerable damage during March. It also was reported on clovers as occurring generally in Ohio (reported as *Gloeosporium trifolii*), Indiana and Illinois (reported as *Gloeosporium caulivorum*), and locally in South Carolina, Iowa (reported as *Gloeosporium trifolii*), and Missouri (reported as *Gloeosporium caulivorum* Kirch.) It is probable that there is more than one anthracnose of clover as is indicated by the different names for the occurrence. The dates when it was first noted in the central states, and which are more or less coincident, were given as follows:

May 10	Illinois	May 17	Indiana
May 13..........	Missouri	May 24	Ohio

Rusts caused by *Uromyces* spp.

Uromyces trifolii (Hed.) Lev. was reported on clover in Vermont, Connecticut, Delaware, Ohio, Arkansas, and North Dakota; on white clover (*Trifolium repens*) from South Carolina, Minnesota, and Oklahoma; and on alsike clover (*T. hybridum*) from Minnesota. The dates of first appearance of this rust were given as follows:

July 2	Minnesota	July	Oklahoma
July 25	Connecticut	September 15	Vermont

Uromyces fallens (Desm.) Kern. was noted on red clover (*Trifolium pratense*) in New Hampshire, New Jersey, South Carolina, Minnesota, Missouri, Nebraska, and Pennsylvania. In the latter state it was said to be less common than usual. The dates when this disease was first noticed are,-

June 9	New Hampshire	June 30	Pennsylvania
June 26	Missouri	July 20	Minnesota

Nematode disease caused by *Tylenchus dipsaci* (Kühn.) Bastian.

This disease, recently reported on by L. P. Byars (Phytopath 10: 91-95, 1920), and R. H. Smith (Jour. Econ. Entomology 12 : 460-462, 1919), was found during 1919 causing heavy losses to red clover crops in many localities in southern Idaho. A map supplied by Hungerford indicates its occurrence in Twin Falls, Cassia, Minidoka, Lincoln, and Gooding Counties, Idaho. According to Byars and Smith the disease is also known to occur on the crop in the irrigated regions of eastern Washington and Oregon, and in central Utah. Information obtained from farmers indicates that it has been present in southern Idaho for several years and has been rapidly increasing in destructiveness.

Regarding the severity of the disease Byars says, "In the Twin Falls, Idaho district it is difficult to find an uninfested field and the damage has been so severe that many farmers the past season have plowed up their clover and planted other crops." This important trouble should be closely guarded in regions where it exists, and a sharp watch should be kept for occurrences in other sections or states.

Other diseases.

Sooty spot, caused by Phyllachora trifolii, occurred in Vermont, where a large proportion of the plants were more or less affected; in Delaware, where 1% injury was estimated; and in Minnesota, where it was collected on Trifolium repens (general, first report June 29), T. pratense (probably general, first report July 20), and T. hybridum (probably general, first report July 2).

Root rot, caused by Sclerotinia trifoliorum Erik., was reported from Ohio (May 5), Tennessee (severe locally on red clover, first seen April 22, and slight on crimson clover, first seen April 7), and Washington (Clarke County, March 21). The report from Washington is one of the first received by the Survey. It has been reported from Oregon, however, a number of times in the past.

Dodder (Cuscuta spp.) Cuscuta epithymum Murr. was said to be greatly on the increase in Delaware, injuring from 15-20% of the clover crop. Dodder was reported common in Arkansas clover fields.

Streak, caused by Bacillus lathyri Manns and Taub., was said by Manns to be common in Delaware, causing a stem blackening and leaf bacteriosis of red, alsike, and mammoth clovers. It was also reported from Hennepin County, Minnesota, June 13, by the Section of Plant Patholoty at St. Paul.

Leaf spot, caused by Cercospora medicaginis E. and E., was reported by E. F. Hopkins as general in Alabama and the cause of considerable loss. It was first noted by Hopkins, April 23.

Leaf spot, caused by Macrosporium sarciniforme Cav., was general late in the season, but not severe in Arkansas according to Elliott.

Crown rot, caused by Sclerotinia libertiana, was severe in parts of Delaware.

Powdery mildew, caused by Erysiphe polygoni, was reported from Washington, and Erysiphe martii was reported from Minnesota on alsike clover.

Root rots, of unknown causes, were reported by Hungerford from southern Idaho and by Leach from Colorado (June 7).

Mosaic, cause unknown, was observed by C. R. Orton on crimson clover in Pennsylvania. He reported as follows: "Fifty per cent of plants on 6 1/2 acres. Most serious case I have ever seen. Plants dwarfed and soon died, rosette produced in many cases. This crop was newly seeded in an orchard."

The disease was also said to be common on red and sweet clovers in Arkansas, where it was noted first in May.

Red leaf, of unknown cause, occurred in Pennsylvania in the same field mentioned above under mosaic. Orton stated that this condition may be associated with the mosaic, but the evidence was not very strong in that direction. The damage was severe.

VETCH (Vicia spp.)

Blight, caused by Ascochyta pisi Lib. was reported from Delaware.

Downy mildew, caused by Peronospora viciae (Berk.) De Bary., was collected on Vicia sativa in the District of Columbia. It occurred locally on the lower parts of the plants.

SWEET CLOVER (Melilotus)

Leaf spot, caused by Cercospora davisii Ell. & Ev. reported from Hennepin County, Minnesota, July 20 on Melilotus alba.

Root rot, caused by Fusarium sp., was said to be severe in New Mexico where 5-90% of the plants were affected. It was found both along the banks of the irrigation ditches and in the fields, according to Leonian.

Ascochyta caulicola Laub., reported from Jefferson County, Indiana, May 23.

COWPEA (Vigna sinensis)

Leaf spot, caused by Cercospora cruenta Sacc., occurred in the following states according to collaborators: New Jersey (common), Georgia (general, 5%, first appeared Aug. 1), Arkansas (common, 50% crop injury), Oklahoma and Texas (prevalent, 1% loss).

Powdery mildew, caused by Erysiphe polygoni De C., was common in South Carolina and Georgia. In both of these states it occurred on a large percentage of the crop and appeared in August.

Wilt, caused by Fusarium sp., was reported from Georgia (general in South, causing 10% loss), Arkansas (scattered), and Louisiana (common in some localities, local variety of black pea in Webster Parish reported by Hollis to be entirely resistant).

Root knot, caused by Heterodera radicicola (Greef.) Mull., was reported common in South Carolina (5% loss), and Arkansas (2% loss). It also caused damage in many other parts of the South but no other reports were received by the Survey.

Leaf spot, caused by Amerosporium oeconomicum Ell. & Tracey, was common in South Carolina.

Pod spot, caused by Cladosporium sp., was found on pods in Cobb County, Georgia, July 21, by G. M. Armstrong. It was also common in Florida, affecting nearly 25% of the crop according to Sherbakoff.

Anthracnose, caused by Colletotrichum, reported from Delaware.

Streak, caused by Bacillus lathyri M. and T., was reported by Manns from Delaware.

Root rot, caused by Ozonium omnivorum Shear, was very prevalent in Texas and present in Oklahoma.

Leaf spot, caused by Phyllosticta phaseolina Sacc., was collected in Jackson County, Indiana, August 29.

Rust, caused by Uromyces sp., was reported by Taubenhaus from Texas.

Rhizoctonia sp., was reported by Matz from Porto Rico, attacking the foliage and pods. The fungus was also said to be the cause of serious root rot in St. James Parish, Louisiana.

SOY BEAN (Soja max)

Bacterial blight, caused by Bacterium glycineum, occurred naturally in the varietal test plots at the Experiment Station at Madison, Wisconsin.

Streak, said to be caused by Bacillus lathyri Manns and Taub., was common in Delaware last year.

A stem rot of undetermined cause was reported in parts of Tennessee. Whole fields showed dwarfed and yellowed plants. A report of a somewhat similar trouble was reported from Clermont County, Ohio.

A leaf spot, cause not given, was collected in Ohio.

VELVET BEAN (Stizolobium deeringianum).

Bacterial leaf spot, caused by Aplanobacter stizolobii Wolf., recently described by Wolf (Phytopath. 10 : 73-80, 1920), occurred in North Carolina, where it had been present in varying amounts during the past four years in widely separated portions of the state.

B. GRASSES

(The nomenclature of grasses is that used by Hitchcock, U. S. Dept. Agr., Bur. Pl. Ind. Bul. 772, 1920.)

TIMOTHY (Phleum pratense L.)

Powdery mildew caused by Erysiphe graminis De C. was reported by the Section of Plant Pathology from Sherburne County, Minnesota; first found June 4.

Ergot caused by Claviceps sp. was found in seven counties in Minnesota. The first record of its occurrence was made July 11.

Leaf blight caused by Scolecotrichum graminis Fckl. was reported from Minnesota (McLeod County, first found June 26), Wisconsin (Dane County), and Idaho (reported by Chas. W. Hungerford as generally prevalent but causing slight loss.)

Scab caused by Fusarium sp. was reported from Ramsey County, Minnesota; first record July 7.

Leaf smut caused by Ustilago striaeformis (West.) Niess. appeared in Pennsylvania (slight loss in Center County; earliest record May 26), Minnesota (Isanti County; first reported June 5), Wisconsin (slight), Iowa (a trace reported by I. E. Melhus; also recorded from Ames on June 19), and Idaho (common in Latah County, but causing only slight loss).

Stem rust caused by Puccinia phlei-pratensis Eriks. & Henn. occurred in Connecticut (occasionally found in New Haven County), West Virginia (generally found in parts of Greenbrier and Summers Counties), Ohio (less prevalent than in preceding years), Minnesota (in 21 counties, causing a loss estimated at 2% for the state; earliest report from Hennepin County, May 30), Missouri (Boone County, loss slight; also reported from Greene County), Idaho (occurrence general, but loss caused very slight).

A blade blight, apparently bacterial, was reported from Ohio by Selby.

RED TOP (Agrostis palustris Huds.)

Powdery mildew caused by Erysiphe graminis De C. was reported from St. Louis County, Minnesota; first found September 17.

Stem rust caused by Puccinia graminis Pers. occurred in West Virginia (generally prevalent and causing severe damage in parts of Summers County; June 24) and in Tennessee (locally severe in Cocke and Unicoi Counties; first observed July 7).

BLUE GRASSES (Poa spp.)

Ergot caused by Claviceps sp. was reported from Minnesota on Poa compressa L. in Lake County (earliest record September 24), and on P. pratensis L. in four counties (first report June 26).

Powdery mildew, caused by Erysiphe graminis De C. was reported on P. pratensis in Minnesota (in 11 counties; injury ranging from slight to severe), and Kansas (generally prevalent in Riley County; injury slight).

Silver top caused by Sporotrichum sp. was common in Iowa.

A leaf spot caused by Septoria sp. on P. pratensis was found in McLeod County, Minnesota; first reported June 26.

A leaf spot caused by Scolecotrichum graminis Fckl. was found on P. pratensis in Fillmore County, Minnesota; first reported June 6.

Anthracnose caused by Colletotrichum cereale Manns. was reported on P. pratensis in Ramsey County, Minnesota; first report August 13.

Leaf rust caused by Puccinia poarum Niess. was reported from Minnesota (on P. compressa in Ramsey County, first report June 30; on P. pratensis in nine counties, injury ranging from slight to moderate, first report May 30, Hennepin County), Iowa (reported as general on Poa sp. in the northern half of the state, appearing very early, June 9-11), Kansas (on P. pratensis in Riley County, May 15), and California (2% infection found on P. compressa May 10).

EUROPEAN MILLET (Panicum miliaceum L.)

Smut caused by Ustilago panici miliacei (Pers.) Wint. was reported as causing slight injury in Colorado. The first record of its occurrence was October 30.

ITALIAN MILLET (Chaetochloa italica (L.) Scribn.)

Smut caused by Ustilago crameri Körn. was found in Minnesota (Ramsey and St. Louis Counties; first report August 2, Ramsey County), and North Dakota (slight infections in Grand Forks and Traill Counties; moderate in Cass County).

ORCHARD GRASS (Dactylis glomerata L.)

Ergot caused by Claviceps sp. occurred in Rice and Ramsey Counties, Minnesota; first report June 25.)

Powdery mildew caused by Erysiphe graminis De C. was reported August 19 from Rice County, Minnesota.

Scab caused by Fusarium sp. was reported as general in certain localities in Greenbrier County, West Virginia.

Anthracnose caused by Colletotrichum cereale Manns. was reported from Minnesota (Ramsey County; first report August 3.)

Stem rust caused by Puccinia graminis Pers. was reported from West Virginia (locally prevalent in Greenbrier and Summers Counties) and Minnesota (in four counties; first report from Todd County, July 4).

BROME GRASSES (Bromus spp.)

Ergot caused by Claviceps sp. was reported on Bromus inermis Leyss. in Minnesota (slight to moderate infections in six counties; first report July 4). It was also reported abundant on Bromus sp. in Cass County, North Dakota.

Powdery mildew caused by Erysiphe graminis De C. was found on B. inermis in Minnesota (Fillmore County).

Leaf spot caused by Helminthosporium sp. was found on B. inermis in Ramsey County, Minnesota, and in three counties in North Dakota.

Scab caused by Fusarium sp. was found on Bromus sp. in Greenbrier County, West Virginia.

Leaf rust caused by Puccinia sp. was found in California on B. hordeaceus L. (April 25 and May 10; amount of infection ranging from 5% to 40%), B. secalinus L. (May 31) and B. villosus Forsk. (leaf rust almost universal; May 6).

Stem rust caused by Puccinia graminis Pers. occurred in West Virginia (Greenbrier and Summers Counties, locally prevalent on B. secalinus); Minnesota (present in slight amounts on B. purgans L. in Ramsey County; first report August 14); and North Dakota (on Bromus sp. in Cass County).

BERMUDA GRASS (Capriola dactylon (L.) Kuntze.)

Leaf rust caused by Puccinia cynodontis La C. was found in California to be prevalent on Bermuda grass along irrigation ditches (April 23).

Rust caused by Puccinia sp. was found in California.

BLUE JOINT GRASS (Calamagrostis canadensis (Michx.) Beauv.)

Ergot caused by Claviceps sp. was found in Minnesota (slight to moderate infections in Hennepin and Washington Counties; first report July 15.)

Leaf spot caused by Phyllachora graminis (Pers.) Fckl. was found in Minnesota (abundant in Washington County; first report August 3).

Rust caused by Puccinia sp. was reported from Washington County, Minnesota (slight injury; first report August 3).

BOTTLE BRUSH GRASS (*Hystrix patula* Moench.)

Epichloe typhina (Pers.) Tul. was abundant in Ramsey County, Minnesota; first report June 24.

Leaf spot caused by *Phyllachora graminis* (Pers.) Fckl. occurred frequently in Hennepin, Rice, and Ramsey Counties, Minnesota; first reported July 12.

BRISTLY FOXTAIL GRASSES (*Chaetochloa* spp.)

Downy mildew caused by *Sclerospora graminicola* (Sacc.) Schr. was reported from Minnesota (in six counties on *Chaetochloa viridis* (L.) Scribn.; first report July 19), and Iowa (very common).

Smut caused by *Ustilago neglecta* Niessl. was reported on *C. lutescens* (Weigel) Stuntz from seven counties in Minnesota (first report Ramsey County, July 13).

CANARY GRASS (*Phalaris* spp.)

Ergot caused by *Claviceps* sp. occurred rather commonly on *Phalaris arundinacea* L. in Ramsey and Goodhue Counties, Minnesota; first report July 21.

Leaf rust caused by *Puccinia majanthae* (Schum.) A. &.H. was found in California on *P. canariensis* L.

Stripe rust caused by *Puccinia glumarum* (Schm.) E. & H. was found by W. W. Mackie in California on *Phalaris paradoxa* L.

CRAB GRASS (*Syntherisma sanguinalis* (L.) Dulac.)

Leaf spot caused by *Piricularia grisea* (Cke.) Sacc. was reported from Goodhue County, Minnesota; first report July 17.

Smut caused by *Ustilago rabenhorstiana* Kühn occurred in Goodhue County, Minnesota; first report July 24.

FESCUE GRASSES (*Festuca* spp.)

Ergot caused by *Claviceps* sp. was found in Minnesota on *Festuca elatior* L. (Hennepin and Ramsey Counties; first report July 11), *F. pratensis* Huds. (Ramsey County, July 10), and *F. rubra-heterophylla* (abundant in Ramsey County, first report July 10).

Anthracnose caused by *Colletotrichum cereale* Manns. was reported from Minnesota on *F. elatior* (Ramsey County, August 13), *F. ovina* L. (considerable in Ramsey County; first report August 13), and *F. rubra* L. (Ramsey County).

A *leaf spot* caused by *Helminthosporium* sp. was very common in Iowa.

Stem rust caused by *Puccinia graminis* Pers. occurred on *F. elatior* in Freeborn County, Minnesota; first report July 2.

MARSH GRASS (Spartina michauxiana Hitch.)

Leaf spot caused by Phyllachora graminis (Pers.) Fckl. occurred in Washington County, Minnesota; first report August 3.

MEADOW FOXTAIL GRASSES (Alopecurus spp.)

Anthracnose caused by Colletotrichum cereale Manns. was found in Ramsey County, Minnesota, on Alopecurus aristulatus Michx. (first report June 28), and on A. pratensis L. (August 13.)

OAT GRASS (Arrhenatherum elatius (L.) Mert. & Koch.

Anthracnose caused by Colletotrichum cereale Manns. was found in Ramsey County, Minnesota.

PANIC GRASSES (Panicum spp.)

Anthracnose caused by Colletotrichum cereale Manns. occurred in Minnesota on Panicum capillare L. (Hennepin County, May 24) and P. virgatum L. (Washington County, August 3).

Rust caused by Puccinia emaculata Schw. was found on P. capillare in McLeod County, Minnesota; first report August 20.

Rust caused by Puccinia panica was reported on P. virgatum in Washington County, Minnesota; first report August 3.

PASPALUM GRASSES (Paspalum spp.)

Ergot caused by Claviceps paspali S. & H. occurred in Louisiana (generally prevalent and severe in several parishes, causing death of cattle in pastures; traces found in Tangipahoa Parish wherever Paspalum was found, no damage to cattle; traces found locally in Calcasieu County, and in Arkansas (very general, injury 90%; earliest report September).

PORCUPINE GRASS (Stipa spartea Trin.)

Smut caused by Ustilago hypodytes (Schl.) Fr. was reported from Waseca County, Minnesota, July 17.

REED GRASS (Calamovilfa longifolia (Hook.) Scribn.

Epichloe typhina (Pers.) Tul. was abundant in Washington County, Minnesota; first reported August 3.

RYE GRASS (*Lolium perenne* L.)

Stem rust caused by *Puccinia graminis* Pers. was reported from Minnesota (Ramsey County, first report August 14).

Stripe rust caused by *Puccinia glumarum* (Schm.) E. & H. occurred in Yakima and Whitman Counties, Washington.

SALT GRASS (*Distichlis spicata*(L.) Greene)

Rust caused by *Puccinia subnitens* Diet. was found in California.

SQUIRREL-TAIL GRASS (*Hordeum jubatum* L.)

Leaf spot caused by *Scolecotrichum graminis* Fckl. was reported from Ramsey County, Minnesota, June 21.

Leaf spot caused by *Septoria graminum* Desm. was found in Freeborn County, Minnesota, July 2.

Leaf rust caused by *Puccinia* sp. was reported as probably general in Hennepin, Ramsey, St. Louis, Todd, and Wadena Counties, Minnesota; first report from Todd County, July 4.

Stem rust caused by *Puccinia graminis* Pers. occurred in 22 counties in Minnesota (slight to abundant; first report Hennepin County, June 17).

WHEAT GRASSES (*Agropyron* spp.)

The following diseases were reported on *Agropyron* spp. in Minnesota:

Ergot caused by *Claviceps* sp. occurred on *A. caninum* (L.) Beauv. Stevens and Hennepin Counties; first report July 18); *A. cristatum* (L.) Gaertn. (Ramsey County; first report July 1); *A. desertorum* (Ramsey County, first report July 1); *A. intermedium* (Ramsey County; first report July 1); *A. repens* (L.) Beauv. (causing slight to severe damage in ten counties; first report July 1); *A. smithii* Rydb. (slight to considerable amounts found in eight counties; first report July 15); *A. tenerum* Vasey (Dakota, Hennepin, and Stevens Counties; first report July 15).

Powdery mildew caused by *Erysiphe graminis* De C. was found on *A. caninum* in Ramsey County (first report May 30), and on *A. repens* in Rice and Ramsey Counties (first report June 2, Ramsey County).

Black leaf spot caused by *Phyllachora graminis* (Pers.) Fckl. was reported as probably general on *A. repens* in Anoka, Chisago, and Ramsey Counties; first report July 5.

Scab caused by *Fusarium* sp. occurred on *A. smithii* in Anoka and Ramsey Counties (first report August 4, Ramsey County).

Anthracnose caused by *Colletortichum cereale* Manns. was found in Ramsey County on *A. desertorum* (first found August 13) and on *A. repens* (first report July 27).

Leaf spot caused by *Septoria graminum* Desm. was reported from Stevens County on *A. caninum* (first report July 28).

Smut caused by *Ustilago macrospora* Desm. occurred on *A. repens* in Ramsey County; first report July 28.

Leaf rust caused by *Puccinia clematidis* was found on *A. caninum* in Stevens County, July 28; on *A. repens* in Hennepin (abundant), McLeod, Washington, and Rice Counties (first report June 26); and on A. tenerum in Stevens and Waseca Counties (first report July 17).

Stem rust caused by Puccinia graminis Pers. occurred on A. caninum in Stevens, Hennepin, and Anoka Counties (damage slight, first report July 28, Stevens County); on A. repens in 14 counties (generally prevalent, causing slight to severe injury; first report June 17, Hennepin County); on A. smithii in Anoka County, September 4; on A. tenerum in five counties (general; injury ranging from moderate to severe; first report July 28, Stevens County).

WILD OATS (Avena spp.)

Powdery mildew caused by Erysiphe graminis De C. occurred in California (May 28).

Stem rust caused by Puccinia graminis Pers. was found in California (May 28).

WILD RYE (Elymus spp.)

The following diseases were found on Elymus spp. in Minnesota:

Ergot caused by Claviceps sp. occurred on E. robustus Scribn. & J.G.Sm. in Nobles County (first report September 6), and on E. virginicus L. in Stevens County.

Epichloe typhina (Pers.) Tul. was found on E. canadensis L. in Anoka, Hennepin, and Ramsey Counties (injury moderate to severe; first report June 29, Hennepin County); on E. robustus in Ramsey County (damage considerable; first report July 13); and on E. virginicus in Ramsey and Hennepin Counties (injury slight, first report June 24.

Powdery mildew caused by Erysiphe graminis De C. occurred on E. canadensis in Ramsey County (first reported June 14); on E. robustus in Washington County (first record August 3); and on E. virginicus in Hennepin County (first appeared July 15.

Leaf spot caused by Phyllachora graminis (Pers.) Fckl. was reported on E. canadensis in five counties (probably generally prevalent, injury moderate to severe; first report July 13); on E. robustus in five counties (damage slight to considerable; first report Anoka County, July 5); on E. striatus Willd. in Hennepin County (abundant; first report August 3); and on E. virginicus in four counties (considerable to abundant; first report July 21).

Smut caused by Ustilago striaeformis (Schl.) Fr. was reported on E. canadensis glaucifolius (Muhl.) Gray in Ramsey County (first report June 22); and on E. robustus in Dakota and Rice Counties (first report (July 20).

Stem rust caused by Puccinia graminis Pers. was found on E. canadensis in Anoka County (September 4); on E. glaucus Buckl. in Swift County (injury very slight; first report July 28); on E. macounii Vasey in Carlton County (considerable; first report September 15); on E. robustus in five counties (abundant in Sherburn County; first report from Ramsey County, July 15); on E. virginicus in Stevens County (injury slight; first report July 28).

A Septoria leaf spot was common and severe in Iowa on Elymus sp. (wild barley).

Leaf rust caused by Puccinia sp. was found on E. triticoides Buckl. in California (5% infection, May 22).

Stem rust caused by Puccinia graminis Pers. was reported from California on Elymus sp. (5% infection, June 29).

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THE PLANT DISEASE BULLETIN

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THE PLANT DISEASE SURVEY

SUPPLEMENT 9

Diseases of Fruit Crops
in the United States in 1919.

May 15, 1920

BUREAU OF PLANT INDUSTRY

UNITED STATES DEPARTMENT OF AGRICULTURE

PLANT DISEASE SURVEY

1919

G. R. Lyman, Pathologist in Charge.

R. J. Haskell, Asst. Pathologist. G. H. Martin, Jr., Asst. Pathologist.

List of Collaborators of the Plant Disease Survey who have made the principal contribution to the 1919 annual summary.

It should be understood that many other collaborators and pathologists have assisted in gathering data within the states but the following list includes those who actually furnished state reports to the Washington office.

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Colorado	Prof. J. G. Leach
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Nevada	Prof. C. W. Lantz
New Hampshire	Dr. O. R. Butler
New Jersey	Dr. M. T. Cook
New Mexico	Prof. L. H. Leonian
New York	Dr. Chas. Chupp
North Carolina	Dr. R. A. Jehle
North Dakota	Prof. H. L. Bolley
Ohio	Prof. A. D. Selby
	Prof. W. G. Stover
Oklahoma	Prof. C. D. Learn
Oregon	Prof. H. P. Barss
	Prof. C. E. Owens
Pennsylvania	Prof. C. R. Orton
Porto Rico	Mr. Julius Matz
South Carolina	Prof. J. L. Seal
South Dakota	Prof. Manley Champlin
Tennessee	Prof. S. H. Essary
Texas	Dr. J. J. Taubenhaus
Utah	Dr. G. R. Hill, Jr.
Vermont	Dr. B. F. Lutman
	Prof. A. H. Gilbert
Virginia	Dr. F. D. Fromme
Washington	Dr. F. D. Heald
	Mr. B. F. Dana
	Mr. A. M. Frank
West Virginia	Dr. N. J. Giddings
	Prof. Anthony Berg
	Dr. J. L. Sheldon
Wisconsin	Dr. R. E. Vaughan
	Prof. W. H. Wright

DISEASES OF FRUIT CROPS IN THE UNITED STATES IN 1919

Prepared by
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FOREWORD

Sources of Information.

The summary of fruit diseases as they occurred in 1919 has been prepared by utilizing reports received by the Plant Disease Survey from various sources as follows:

1. Reports of collaborators, whose names are listed on the opposite page. Practically all of these persons replied to questionnaires submitted to them at intervals during the growing season and the majority of them sent in annual reports at the close of the year. It is to be regretted, however, that annual reports were not received from a number of important agricultural states, namely, Maine, Massachusetts, New York, Maryland, Michigan, Montana, Wyoming, Arizona, Utah, and Oregon. The information at hand from the important fruit state of California was also extremely meager.

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*Office of Fruit Disease Investigations, temporarily transferred to the Plant Disease Survey.

2. Reports of specialists in the Bureau of Plant Industry, particularly in the Office of Fruit Disease Investigations. Noteworthy contributions appear in subsequent pages from M. B. Waite, C. L. Shear, Charles Brooks, J. W. Roberts, W. S. Ballard, D. F. Fisher, and R. B. Wilcox, and valuable suggestions were made by H. R. Fulton and O. F. Burger.

3. Reports of food products inspectors of the Bureau of Markets. The certificates of these inspectors, of whom there are nearly 50 in number located in about 24 of the larger cities, are available to the Survey for examination. Certain data pertaining to losses were extracted and the results are presented, for the most part in tabular form, in the following pages.

4. Miscellaneous reports and records of the Plant Disease Survey. Abstracts were made from correspondence, news letters, papers, etc., and some, but not all, of the most recent publications giving 1919 data have been examined.

Methods and Estimates.

In writing these summaries the following order was usually used in arranging data for each disease:

1. Geographical distribution
2. Economic importance
3. Dates of first appearance
4. Varietal susceptibility
5. Control

In the case of some important diseases, accumulated reports over a period of several years were used as the basis for a general summary of occurrence, importance and varietal resistance. It is the intention of the Survey to include similar reviews of other diseases from time to time along with current year summaries.

Statistics on crop production in 1919 were taken from the Monthly Crop Reporter, Vol. 5, Dec. 1919, of the Bureau of Crop Estimates. In the calculation of percentages and losses it has been necessary generally to adopt the state as the unit, because both crop production figures and collaborators' reports are calculated in that unit, and not by counties. In maping the distribution and relative prevalence of a given disease, however, an attempt was made to ignore state boundaries wherever reports and other sources of information were sufficiently in detail to make it possible.

The estimates of losses are largely those of collaborators, or are compiled from an accumulation of their reports. These estimates are necessarily rough, but after carefully comparing reports from adjacent territories and submitting the data to pathologists who are specialists on the disease in question, it is felt that the figures are conservative. In writing these summaries an attempt has been made to pay particular attention to the important fruit producing sections, and to correlate severity of the various diseases with the importance of the crop in those sections.

Reports on well known diseases from regions of usual occurrence have been accepted, with occasional modifications of estimates where it seemed necessary. Considerable responsibility, however, is connected with the reporting of a disease for the first time in the United States, or with noting initial occurrence in a new locality or on an unusual host. When coming from reliable sources, such reports have been included in this summary, but persons interested should take up the matter of verification with the pathologist making the report. The Survey has not in all cases checked such reports with specimens and cannot take the responsibility for their accuracy unless specifically stated.

Where sufficient data were at hand, estimates of total losses from a given disease have been tabulated, but in the case of many important diseases causing indirect losses this has been impossible. Notably is this true with such devitalizing diseases as root rots, crown gall, apple powdery mildew in the West, and peach leaf curl. Confusion in estimates from two or more diseases affecting the same fruit has necessarily resulted in some duplication, particularly in the case of reports of inspectors of the Bureau of Markets.

Names of varieties have been made to conform with official nomenclature, and when reported under a synonym the latter is given in parenthesis.

Suggestions for 1920.

Observance of the following suggestions would enable the Survey to improve the summary next year. Failure of collaborators in some important territories to file reports has frequently caused embarrassment in estimating losses. All collaborators are urged to prepare their reports, and to make them as timely, accurate and complete as possible. Reports of occurrence and relative prevalence by counties is of great assistance in plotting distribution maps. The symbols recommended by the Survey are as follows:

⊕ = very severe
+ = severe
V = medium
- = slight
⊖ = very slight

In the case of such diseases as black rot of the apple, for example, which may affect limbs, foliage, and fruit, it would often clarify reports if the nature of the attack was specified. Also in giving dates of first appearance, which are very valuable, it should be recorded in what county or town the disease was observed and what parts of the plant were affected. In reporting varietal susceptibility care should be taken to give comparative data on plants which are reasonably comparable in age and vigor.

The Survey takes this opportunity to state that credit for any service which may be derived from this summary is largely due to the careful and painstaking reports of collaborators in several important states, and to numerous notes and criticisms given by pathologists of the Office of Fruit Disease Investigations of the United States Department of Agriculture.

DISEASES OF POME FRUITS

APPLE

Scab caused by *Venturia inaequalis* (Cke.) Wint.

Favored by early and continued rains together with cool temperatures which prevailed over most of the eastern and central apple growing regions for about one month after the blooming period, apple scab, in 1919, appeared in many states with unprecedented severity and resulted in enormous losses.

The disease was unusually severe in the Upper Mississippi Valley, the Great Lakes region and the Appalachian fruit belt from Pennsylvania to North Carolina and Tennessee, and extended over parts of the Coastal Plain. Prevalence of scab over these regions is reported as follows by collaborators: Minnesota (Bisby) - Unusually common and severe. Wisconsin (Vaughan) - More scab than for several seasons. Michigan (Coons) - Exceedingly prevalent in spite of dry weather, experienced an enormous loss. Illinois (Anderson) - Bad throughout state, caused exceptional foliage injury. Indiana (Gardner) - Most severe apple disease in Indiana this year, although blossoms and young fruits suffered heavily, infection of older fruits not as bad as might have been expected. Ohio (Selby) - Scab much worse than usual, general over whole state. Pennsylvania (Orton) - Apparently general throughout state, most serious outbreak in several years, 100% infection in Cumberland, Huntingdon, and Center counties. New York (Chupp) - More severe than usual. Delaware - General throughout state, very common on early varieties in spite of vigorous spraying. Virginia (Fromme) - Unusually severe, scabbiest year in history of apple industry in the state. West Virginia (Giddings) - More prevalent than any year since 1909. Tennessee (Essary) - Unusually severe this season. Missouri - The disease is more abundant south of the Missouri River, but pretty well controlled in sprayed orchards.

Of the New England states, Massachusetts (Osmun) reported scab more prevalent and severe than for several years. In Maine losses were reported extensive and severe June 6, but less severe July 1. Vermont reported much less than average due to dry summer. New Hampshire - Moderately abundant. Connecticut (Clinton) - Somewhat more pronounced than for normal season.

The southern tier of apple producing states from Oklahoma and Arkansas to South Carolina suffered as usual a loss of about 1% - very much less than their neighbors to the north. Arkansas (Elliott) reported scab well controlled in commerical orchards, loss about 1/2%.

West of the 100th meridian apple scab was reported as follows in 1919: Montana - Scab of little consequence this year. None in sprayed orchards, some losses locally in unsprayed orchards. Idaho (Hungerford) - Very little scab in northern Idaho as compared with former years; injury 0.5%, loss 0.2%. No scab noted anywhere in southern Idaho in June. Washington (Heald) - Scab very common and severe in western Washington, very little in eastern Washington - less prevalent than usual, and none in central irrigated Washington. Oregon (Barss) - Moist weather of early June resulted in some scab development, but crop appears in general to be rather clean. California - Apple scab is known to be widely distributed in this state, but no statement of losses has been reported to the Survey in recent years. In 1903 Newton B. Pierce stated: "This disease has caused considerable loss in California in 1903, its present distribution largely covers the apple growing districts of the state", and again in 1905 Pierce reported: "The disease gradually spreading to all apple sections (California)".

Other interior western states reported as follows in 1919: Colorado (Leach) - "Have observed none this year." New Mexico - None observed, believed not to be present. Arizona - Reported absent from every county in the state.

M. B. Waite, United States Department of Agriculture, comments as follows upon the occurrence of apple scab in 1919:

"From field observations in parts of Maryland and Virginia adjacent to Washington, and in the Shenandoah Valley of Virginia, and from conversation with fruit growers, specimens and correspondence, data have accumulated to show a very unusual outbreak of apple scab from New Jersey to North Carolina. The district in question includes the entire Appalachian Fruit Belt and the Piedmont Plateau, as well as adjacent sections on the Coastal Plain, particularly towards the north. It is probably the worst outbreak of apple scab for thirty years or perhaps that has ever been reported. Similar outbreaks have occurred in New York and New England, the Great Lakes apple orchards, and in the Upper Mississippi Valley in previous seasons, but never before so bad generally in this district.

"As an indication of the severity of this attack, examples of scab attacking the fruit of the York Imperial turned up quite generally from this district, and in some instances, the fruit of this variety was damaged to the extent of 25% by this disease. This is unprecedented. Previous to 1919, the writer had personally seen the disease on the York Imperial fruit in but a few scattered instances. Twice it was found at Winchester, Virginia on small, greenish York Imperial fruits in the autumn and on less than a dozen specimens. The trees from which these came were badly attacked by cedar rust. At the time it was thought that these delicate, thin-skin York Imperial fruits, resulting from cedar rust attacks, were thus rendered much more susceptible to the scab fungus, and it may be suggested as a possibility that the resistance of the York Imperial to scab may have been reduced by cedar rust to some extent. The foliage of York Imperial has always been relatively susceptible to the scab, but not the fruit. That reduced vitality from cedar rust is not the main factor in this outbreak, however, is obvious since the Winesap, Stayman Winesap, Paragon or Mammoth Black Twig, (the Winesap Group), not attacked by cedar rust have been in this outbreak, as usual, badly attacked by the scab. Rome, Yellow Newtown, Ben Davis and many other varieties have been severely injured by scab in the region mentioned during the past year.

"While this apple scab outbreak was bad on the Coastal Plain in New Jersey and the Delaware-Chesapeake peninsula, some observations at certain points on the Coastal Plain in Maryland and Virginia showed a small amount of apple scab even under these remarkable infection conditions. I think I can now recall that scab has generally been slight on the Coastal Plain from Baltimore southward, except on the Delaware-Chesapeake peninsula, which is inclined to be cooler and moister, but the fact that in Maryland scab was abundant in the Piedmont region and scarce on the Coastal Plain at points less than twenty miles apart, deserves notice. I am inclined to attribute this to the lack of previous infection; in other words, there must have been few scab spores to make use of the unusual infection conditions.

"The main reason for this great outbreak of apple scab can be directly attributable to the unusual weather conditions in late April and during the month of May. The accumulation of scab during previous years was evidently a factor, but there was altogether too much rainy, cloudy and damp weather during an entire month, beginning about the time the apple trees came into bloom. For example, the official Weather Bureau meteorological records at Washington, D. C., beginning April 24 and ending May 24 show only three periods with clear weather - one clear day April 24, two clear days ~~April~~ May 2 and 3, and two clear days ~~April~~ May 18 and 19. During this period of thirty-one days, there were rains on twenty-one days, counting those in which a trace is recorded, and a trace is probably as effective on cloudy days as a heavier rain, not to mention the heavy dews with which the fruit and foliage were saturated on other cloudy days. Of the twenty-one days with rain, only six were marked "partly cloudy", which means that the sun shone through the clouds part of the time. The other fifteen days were cloudy all day. Of the ten days in which no rain fell, five only have already been accounted for as clear. Of the remaining five days, two were cloudy and three were partly cloudy.

"It is evident that there was almost a continuous infection period for thirty-one days, beginning when the apple trees were in bloom in the middle portion of this region, slightly preceding bloom in the northern sections, but following closely after bloom in the southern sections, and in general, occurring at the most dangerous period from the standpoint of apple scab. This is plainly the most important factor in the outbreak."

For corrected percentage losses by states from apple scab in 1919 see Plant Disease Bulletin, Supplement 12, 1920. Reports covering practically all of the apple producing regions east of the 100th meridian, representing 67% of the total apple production of the country in 1919, indicate that the apple crop over this area suffered a loss of more than 5 1/2%, or in the neighborhood of 5,760,000 bushels from scab. About one-half of this loss occurred in New York, Pennsylvania, Michigan and Wisconsin, where local losses from scab were not far from 10%. About one-fourth of it occurred in the central states from Missouri to Virginia and North Carolina where local losses by states ran from 3% to 6%. Perhaps one-eighth of it occurred in New England, New Jersey and Delaware. Less than 1 1/2% occurred in the southern tier of apple states from Oklahoma and Texas to South Carolina.

Western apple production (west of the 100th meridian) amounted in 1919 to about 33% of the total apple crop of the country. Of this amount, one-third, or roughly 11% of the total United States crop was subjected to more or less loss from apple scab in California, Oregon and western Washington. Two-thirds of the western apple crop in 1919, or roughly 22% of the total United States crop for that year was produced in central and eastern Washington, Idaho, Montana Colorado, Utah, Arizona, and New Mexico, where losses from scab were from zero to a trace.

Out of 2973 cars of apples inspected at destinations by Bureau of Markets inspectors, 46 cars were found to be affected with scab as follows:

Table 20. Losses as shown by inspection of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	No. of cars with scab	Average percentage of scab	Range of percentage of scab	Remarks as to seriousness of scab.
Arkansas	1	17	15-20%	Badly scabbed.
Canada	1	9	8-10%	
Colorado	1	2	2%	Slightly scabbed.
Delaware	2	16	11-22%	
Illinois	3	10	10%	
Kansas	1	9	8-10%	
Maine	1	5	5%	Slightly scabbed.
Maryland	3	25	15-35%	Badly scabbed.
Massachusetts	1	8	8%	
Michigan	10	16	3 cars 28-43%	Badly scabbed, includes other blemishes in estimates.
			7 cars 2-20%	Other blemishes included also.
New York	11	20	2 cars 50-80%	Scab appears in small spots.
			9 cars 2-22%	Bad scab in some cars.
Oregon	1	33	33%	Mostly in small spots.
Pennsylvania	1	3	3%	Badly scabbed.
Virginia	6	18	9-30%	Other blemishes included in estimates.
West Virginia	3	22	1 car 55%	Scab found in small spots.
			2 cars 4-6%	Slightly scabby.

Varietal susceptibility in 1919 was reported as follows by collaborators:

Susceptible

Connecticut: McIntosh
Crab
Martha

New York: Ben Davis
"Greening"
King
Northern Spy
McIntosh

Pennsylvania: Stayman Winesap
Delicious
Gano
Banana
Jonathan
King
Grimes (More than usual)

Pennsylvania (cont.): Star - (More than usual)
Transparent (10%)

Virginia: Winesap family
Yellow Newtown
Arkansas
Delicious
Stayman Winesap
Limbertwig
Virginia Beauty
Paragon
Ben Davis

Missouri: Winesap family
June
Jonathan
Gano
Ben Davis

Resistant

New Hampshire:	Baldwin (Generally free)	Connecticut:	Baldwin Russet
Virginia:	York Imperial (Slight to no infedtion) Grimes	New York:	Baldwin Russet Wealthy Oldenburg
Missouri:	Rome		

Control of apple scab in 1919 was commented on by collaborators as follows:

Massachusetts: (Osmun) Many cases of spray injury traceable to primary injury by Venturia inaequalis.

New York: Early plowed orchards gave best control. Orchards sprayed thoroughly with pink spray are very clean. Spraying about three times the general practice in commercial orchards.

Pennsylvania: Forty percent of fruit infected, 100% on susceptible varieties - usually associated with neglect in applying pink blossom spray.

Delaware: Vigorous spraying did not control scab on early varieties.

Virginia: Proper spraying gave satisfactory control; heavy loss in Shenandoah Valley attributed to fact that "pink" spray was not applied.

West Virginia: Best results with Bordeaux.

Tennessee: Held in check by spraying.

Ohio: Bordeaux pre-blossom spray excellent. Much loss through abandonment of Bordeaux sprays for lime-sulphur.

Indiana: Bordeaux spray fairly successful, sulphur dust not reliable.

Illinois: (Anderson) Regular lime-sulphur sprays when properly applied gave good control.

Michigan: Carefully sprayed - satisfactory; carelessly sprayed - heavy loss; unsprayed - no first class fruit.

Wisconsin: Lime-sulphur has proven to be better than Bordeaux chiefly because less russeting, pre-pink spray gave best results.

Minnesota: Controlled by dusting and spraying in experimental plots.

Iowa: Ordinary spraying not fully effective.

Missouri: Pretty well controlled in orchards where spraying is practical. Lime-sulphur or Bordeaux effective.

Arkansas: Unsprayed fruit badly damaged. Liquid sprays, including lime-sulphur, gave complete control.

Oregon: Bad only in orchards not properly sprayed.

Regarding the value of sulphur dust for the control of scab and other apple diseases collaborators have furnished the following opinions:

Connecticut: "Dusting seems to be coming in a little more than past years, but as yet is used in only a limited way. I know of one case where good results seemed to come from the use of sulphur dust in dusting apples for scab." Clinton.

Virginia: "Sulphur dust has given fair control of scab and was worthless for bitter-rot. With arsenate of lead it has proven the equal of liquid for codling moth. Bordeaux dust found worthless for bitter-rot but but very effective for blotch (Phyllosticta) and frog-eye leaf spot." Fromme.

West Virginia: "I may say that our opinion has not changed very much as to the value of sulphur dust. It certainly does not give good results for control of apple diseases this year, but I am still hoping that some good may come out of it." Giddings.

Arkansas: "A complete failure in the control of any disease of the apple. Orchards that have used dust for the last two or three years were almost ruined by bitter-rot this year." Elliott.

Michigan: "Probably controls scab in ordinary years."

Minnesota: "Valuable. Found about equal to Bordeaux in experimental tests." Bisby.

Referring to control of apple scab in 1919 in the Applachian Fruit Belt, the Piedmont Plateau, and adjacent sections of the Coastal Plain, M. B. Waite makes the following statement:

> "The full apple scab spray treatment has not ordinarily been necessary in this region, and even the better sprayed orchards were usually given only the calyx spray and the two later sprays. In two cases near Vienna, Virginia, orchards given this routine treatment and sprayed thoroughly gave excellent commercial results. In Montgomery county, Maryland, a group of orchards, either dusted at the time of the calyx spray with arsenates or unsprayed, resulted in very severe losses."

Errett Wallace, United States Department of Agriculture, submits the following statement concerning the control of apple scab:

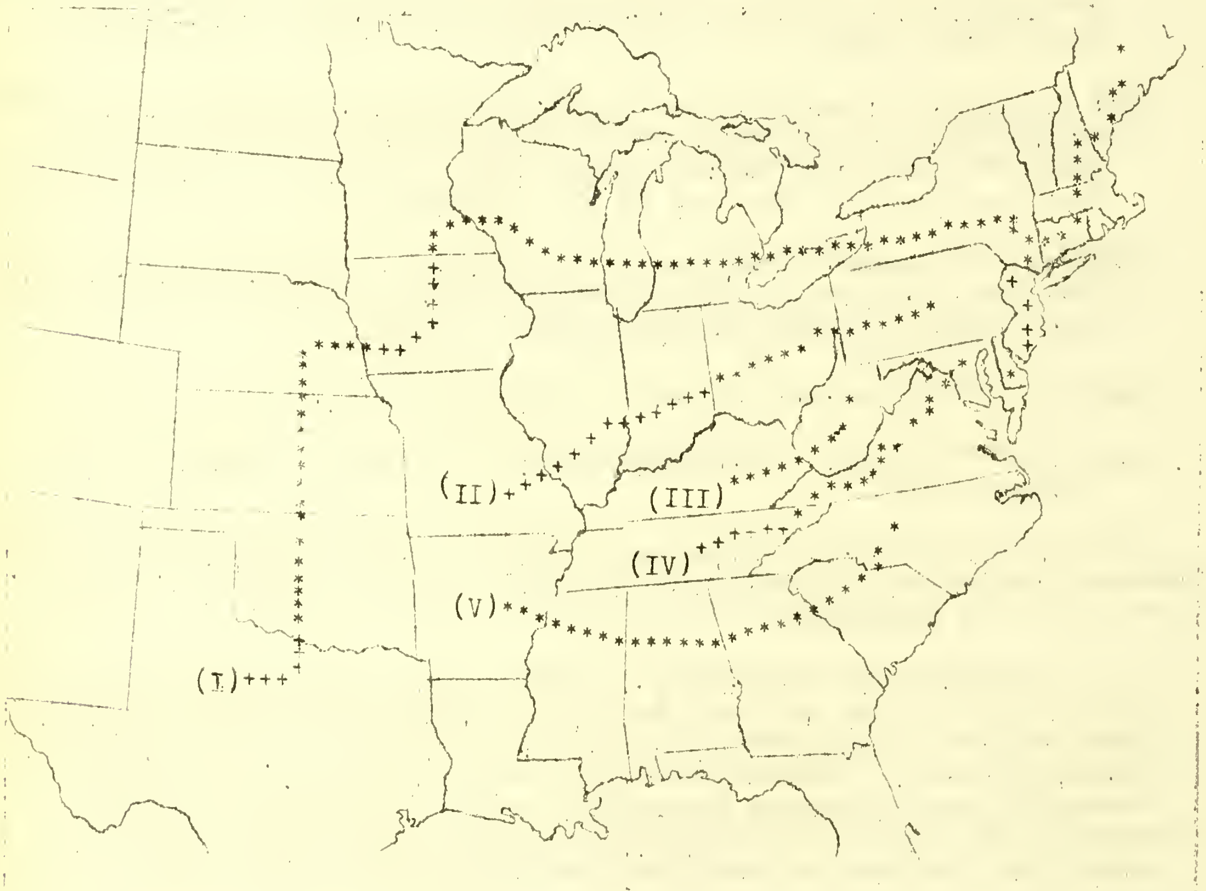
> "In our tests for the past nine or ten years lime sulphur solution combined with lead arsenate has been used in comparison with practically all types of fungicides which have been advocated for this disease, and thus far we have found nothing better, all things considered, at least for the localities in which our work has been conducted. It has given

satisfactory control under the worst epidemic conditions and caused less injury both to fruit and foliage than any other equally effective preparation."

Bitter rot caused by Glomerella cingulata (Stonem) S. & S.

Since 1903 bitter rot of the apple has been reported at least once from every state east of the Mississippi River except Vermont and Florida. All of the states bordering the Mississippi on the west have reported it, also Nebraska, Kansas, Oklahoma, Texas, and New Mexico.

A conservative average of the percentage losses by states to the total apple crop from bitter rot during the past seventeen years, as indicated by the reports filed during that period, makes it possible to divide the area where bitter rot is known into five relative groups. The accompanying map indicates this grouping at a glance. In states where losses are heaviest for the group, a "+" replaces the "*".



Group I. Occurrence, losses negligible.
Group II. Average annual losses for group about 4.5%
Group III. " " " " " " 2.0%
Group IV. " " " " " " 5.5%
Group V. " " " " " " 12.0%

Fig. 22. States grouped according to average percentage losses from bitter rot.

Group I, in which losses are negligible to slight and of small importance, will be seen to include New England, New York, New Jersey, Delaware, Michigan, Wisconsin, Minnesota, Iowa, Nebraska, Kansas, Oklahoma, and Texas. Massachusetts and New Jersey average slight to negligible losses, such losses in Massachusetts often affecting apples stored in bins. Iowa averages about 0.5%; Texas may run as high as 1%.

Group II includes Pennsylvania, Ohio, Indiana, Illinois, and Missouri. The first two states average about 4% loss and the figure is a trifle higher for Indiana and Illinois. Greatest loss for the group is sustained in Missouri. The principal loss is in southern part of these states.

Group III includes only West Virginia and Kentucky. Reports from Kentucky are very meagre, but indicate that losses may approximate 1.5%, while West Virginia reports consistently an average of about 2%. It is interesting to note this region of slight infection surrounded on all sides by areas of heavy infection. John W. Roberts comments upon this area as follows:

> "The difference in the percentage of bitter rot in Virginia and West Virginia is due largely to the fact that the Yellow Newtown is not grown to any extent in the latter state. Virginia's higher rate is due to the large plantings of this variety in the Piedmont section."

Group IV includes Maryland, Virginia, and Tennessee, where losses to the total apple crop in the respective states averages 5% for Maryland and Virginia and 6% for Tennessee.

Group V. South of the line marking the southern boundaries of Virginia and Tennessee is the region where heaviest percentage losses from bitter rot occur. In group V the following losses per year are very common: North Carolina 10%, South Carolina 15%, Georgia 10%, Alabama 10%, and Arkansas 8%.

> "Bitter rot is typically a disease of humid hot sections, extreme heat being especially favorable for its development. Those sections in which there are periods of extreme heat without appreciable temperature diminution at night with occasional showers or rainy periods are especially well situated for the development of bitter rot." (J. W. Roberts)

In estimating percentage losses the values given in Table 21, which follows, are considerably influenced by very heavy losses before the pathogene and its control was well understood in all important sections. For example, Selby reported 25% loss in Ohio in 1905 and 50% in certain localities in 1910. Arthur reported 40% loss in Indiana in 1905. Rolfs reported 40% injury in Missouri in 1906, 25% in 1910. With improved methods of control and the gradual elimination of extremely susceptible varieties, these estimates will no doubt continue to be reduced. Also with more accurate and complete reports, especially by counties and localities, instead of by states alone, the grouping by states here presented, may be rearranged. Not only is this true of bitter rot, but of other diseases as well.

The average annual loss given in the following table is sustained in the area included in groups II to V, which produces about 40% of the average total crop, and 30% of the average commercial crop of the country. About 60% of the normal total production and 70% of the normal commercial production of the country is free from this disease.

We may roughly estimate the average importance of bitter rot to the apple industry of the United States as follows:

Table 21. Average relative importance of bitter rot, production of 1918 used as basis.

Groups	Importance of area. Percentage of U. S. apple crop produced in 1918		Average percentage of total crop in area lost from bitter rot	Average percentage of total U. S. crop lost in area	Bushels lost
	Total	Commercial			
Apple producing states where bitter rot is not reported by collaborators	20	31	0	0	0
Group I - New England, N.Y., N.J., Del., Mich., Wis., Minn., Iowa, Nebr., Kans., Okla., Tex.	40+	39	Negligible	Negligible	Negligible
Group II - Mo., Ill. Ind., Ohio, Pa.	20-	14	4.5	0.9	1,500,000
Group III - Ky., W. Va.,	5	4.5	2	0.1	170,000
Group IV - Md., Va., Tenn.	10+	9.5	5.5	0.55	930,000
Group V - Miss., Ala., Ga., S.C., N. C., Ark.* (Av. loss 8%)	5+	2	12	0.6	1,000,000

An estimate of the average annual loss to the total U. S. apple crop from bitter rot amounts to about 2%, or in the neighborhood of 3,000,000 bu.

Regions of heaviest annual loss, according to the best of our knowledge, are shown by the heavily shaded portions of the accompanying map (Fig. 23). Isolated cases of severe infection, of course, occur outside this area. Appreciable losses, 2% or more, are liable to occur over the entire area indicated by shading and light lines. States in which losses are negligible are marked with an asterisk (*).

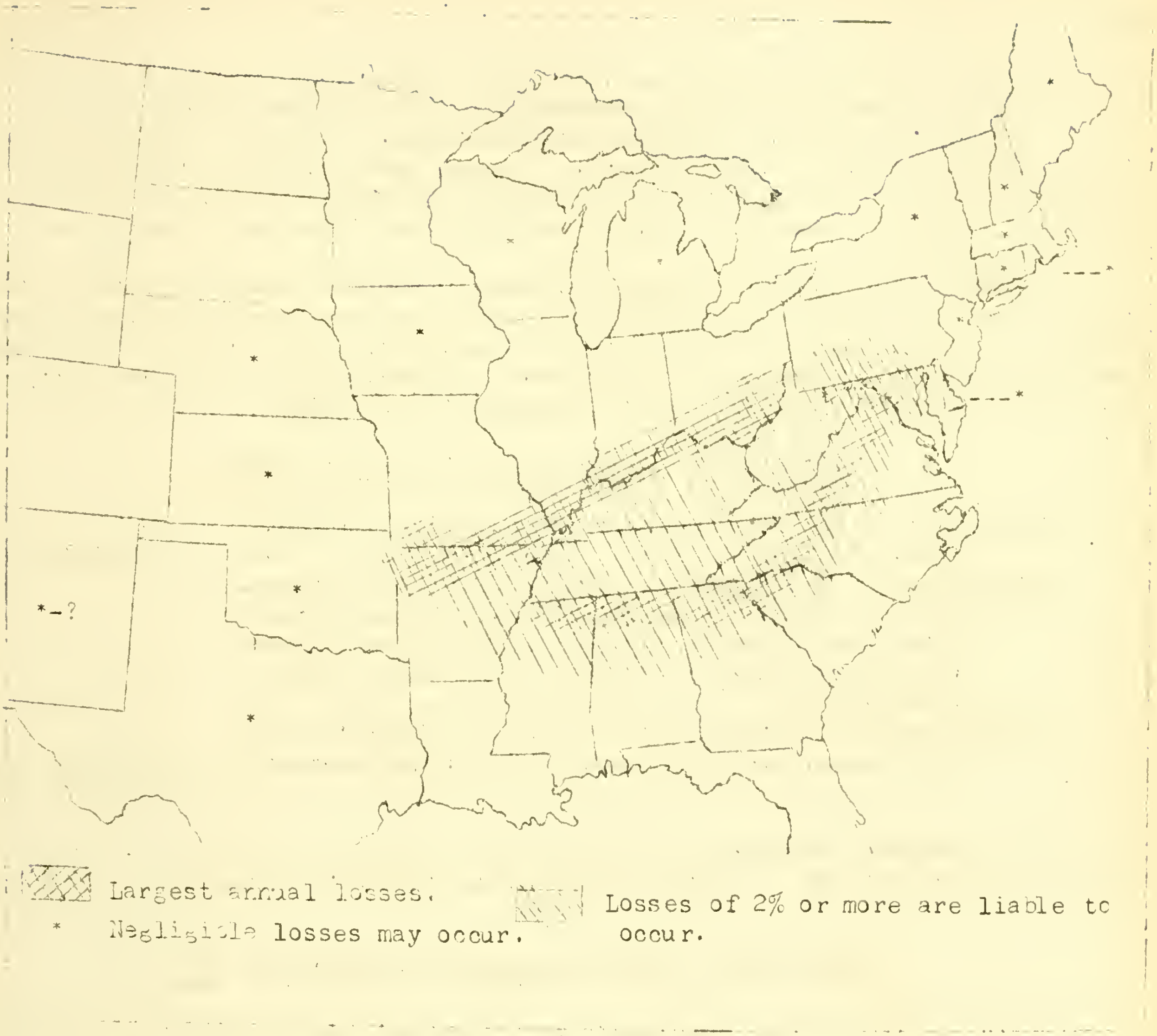

*–?
▨ Largest annual losses.
* Negligible losses may occur.
▨ Losses of 2% or more are liable to occur.

Fig. 23. The bitter rot belt.

Bitter rot in 1919

Collaborators' reports on the relative prevalence of bitter rot in 1919 indicate that in the northern tier of states, comprising Group I, where injury is negligible to slight, behavior of the disease was apparently about normal. Massachusetts reported: "More than usual, amount on both early and late varieties, not of great importance". New Jersey (Cook) reported: "More severe than usual". Michigan (Coons) reported: "No bitter rot found on Michigan fruit, common on Pennsylvania and Illinois apples shipped to Detroit". Texas reported 1% loss.

Group II reported uniformily 2 to 3% less damage than usual in 1919. Pennsylvania 1%, Ohio 1%, Indiana 1%, Illinois 1-%, Missouri 2%. Pennsylvania (Orton) stated that infection was local in Adams, Bucks, and Center counties. Ohio (Selby) reported this disease in southeastern Ohio, less severe than usual. Missouri (Maneval): "Generally distributed throughout state, percentage small to moderate."

Group III (Kentucky and West Virginia): Injury apparently less than usual. West Virginia (Giddings) reported injury as "Slight, 1%".

Group IV (Maryland, Virginia, and Tennessee). Virginia suffered an unusually severe attack for recent years. Fromme reported: "More prevalent and destructive than for several years, excessive rainfall, 5% loss, $500,000". Tennessee (Essary) reported: "Bitter rot is common, loss not so heavy as in previous seasons".

Group V (Arkansas, Mississippi, Alabama, Georgia, North Carolina, and South Carolina) in 1919 suffered their usual heavy loss from bitter rot. Arkansas (Elliot) reported: "Worst infection in several years, some orchards badly damaged, loss 5%, $225,000". Losses in Alabama were estimated at 7%. Georgia (Berry) 10%, South Carolina (Seal) 25%, North Carolina (Jehle) 5%.

Summary of losses from bitter rot in 1919.

Virginia and Arkansas -heavier than usual for recent years, 5% loss or	710,000 bu.
Pennsylvania, Ohio, Indiana, Illinois, Missouri, average 2 to 3% less loss than usual. Estimates are placed at 1%, which together with 1% loss in West Virginia, Kentucky, Tennessee, and Texas makes a total of	300,000 "
North Carolina, South Carolina, Georgia, Alabama, and Mississippi probably lost in the neighborhood of -	220,000 "
	1,230,000 "

The estimates of losses from bitter rot in 1919 are thus seen to be about 1,230,000 bushels, or 0.84% of the total crop of the country.

Data received on varietal susceptibility, 1919

Massachusetts: More than usual amount on both early and late varieties.
Pennsylvania: Severe on Smith (Smith Cider), York Stripe, Stayman, Black Twig, Maiden Blush. Also infection on York Imperial.
Virginia: Susceptible - Yellow Newtown (especially susceptible)
Georgia: Susceptible - Early varieties more susceptible.
Ohio: Reported on Jonathan.
Missouri: Reported on Gano, Ben Davis, Rambo.
Arkansas: Early Harvest, Transparent, Gano, Ben Davis, Givens (especially susceptible), Jonathan, and nearly every other variety.

Dates of first appearance, 1919.

Pennsylvania	-	August 17	-	Bucks County
Virginia	-	July 7	-	Franklin County
Georgia	-	May 18		
Arkansas	-	June 25		

Control measures reported by states.

Virginia: (Fromme) Early appearance and continued rainfall made it a difficult disease to combat this year. Very satisfactory control with early thorough spraying. Early and thorough spraying with Bordeaux gave good control.

North Carolina: (Jehle) Usually controlled by spraying.

South Carolina: (Seal) Fair control when spray was used.

Ohio: (Selby) Control measures effective when applied in time. Copper sprays in July good.

Missouri: (Maneval) Spraying effective in control.

Arkansas: (Elliott) Worst infection in several years. Some orchards badly damaged, notably those which were dusted and where Bordeaux was not applied in July. Bordeaux and pruning effective.

Blotch caused by *Phyllosticta solitaria* E. & E.

Apple blotch, so far as known, occurs only in the Central and Southern states of the eastern half of the country. It has apparently not advanced beyond the northern borders of New Jersey, Pennsylvania, Ohio, Indiana, Illinois, and Iowa. One case was reported from a nursery in Wabasha county, Minnesota, in 1917 on imported nursery stock, but it is understood to have been eradicated. It is reported from a few localities in South Dakota, and is abundant in Nebraska, Kansas, Oklahoma. and Texas, but is not known to occur farther west.

During the period 1905--1907 apple blotch was causing heavy losses in Missouri and Arkansas and was reported as severe and increasing in southern Illinois. It was also very prevalent over the less important southern apple regions east of the Mississippi and south of Virginia, and was being noted in many nearby states farther to the north and west. From 1910 to 1912 reports of the appearance of blotch in new localities and of its rapid increase came from Oklahoma, Kansas, Nebraska, Iowa, Indiana, and Ohio. From 1912 to 1919 the progress of this disease in its advance northward is recorded by several of the states. Virginia (Fromme) 1917 - "Not common"; 1918 - "More reports than in any previous year"; 1919 - "The disease seems to be increasing rapidly in Virginia orchards. It may be found only on a tree here and there, but in a few cases is the most important pest". West Virginia, 1910 - "Small amount"; 1914 - "Believed to be increasing, destructive locally"; 1915 -"More abundant"; 1917 - "Occurs locally at several points, but not of great importance." Delaware, 1912 - "Two cases"; 1915 - "Fairly prevalent"; 1916 -"More prevalent"; 1917 - "More prevalent"; 1919 - "Increasing". Pennsylvania (Orton)- 1914 - "Likely to prove one of our worst apple diseases"; 1915 - "Increasing"; 1917 - "More than usual, the disease has been spreading rapidly the last three years"; 1918 - "On the increase every year, fast becoming one of the most serious apple diseases in Pennsylvania." Ohio (Selby) 1910 - "Reported for the first time from 7 counties"; 1911 - "Collected from 16 counties"; 1914 - "More"; 1915 - "Epidemic in Ohio the past three years"; 1916 - "Rather more"; 1918 - "More, ranks second only to fire blight for its seriousness in Ohio. It has prevailed on a largely increasing number of varieties, one of the serious midsummer diseases of the apple." Indiana (Gardner) 1912 - "Getting to be a bad disease in the southern part of the state"; 1916 - "Quite common, southern part of the state"; 1919 - "Especially prevalent in the southern and central part, second disease in importance in this state this year (scab first)". Illinois 1907 - "Considerable"; 1912 - "Severe on certain varieties"; 1918 - "80% infection on Ben Davis in many sprayed orchards, losses of 10 to 30 per cent of the fruit common"; 1919 - "More serious than usual". Iowa 1909 - "In

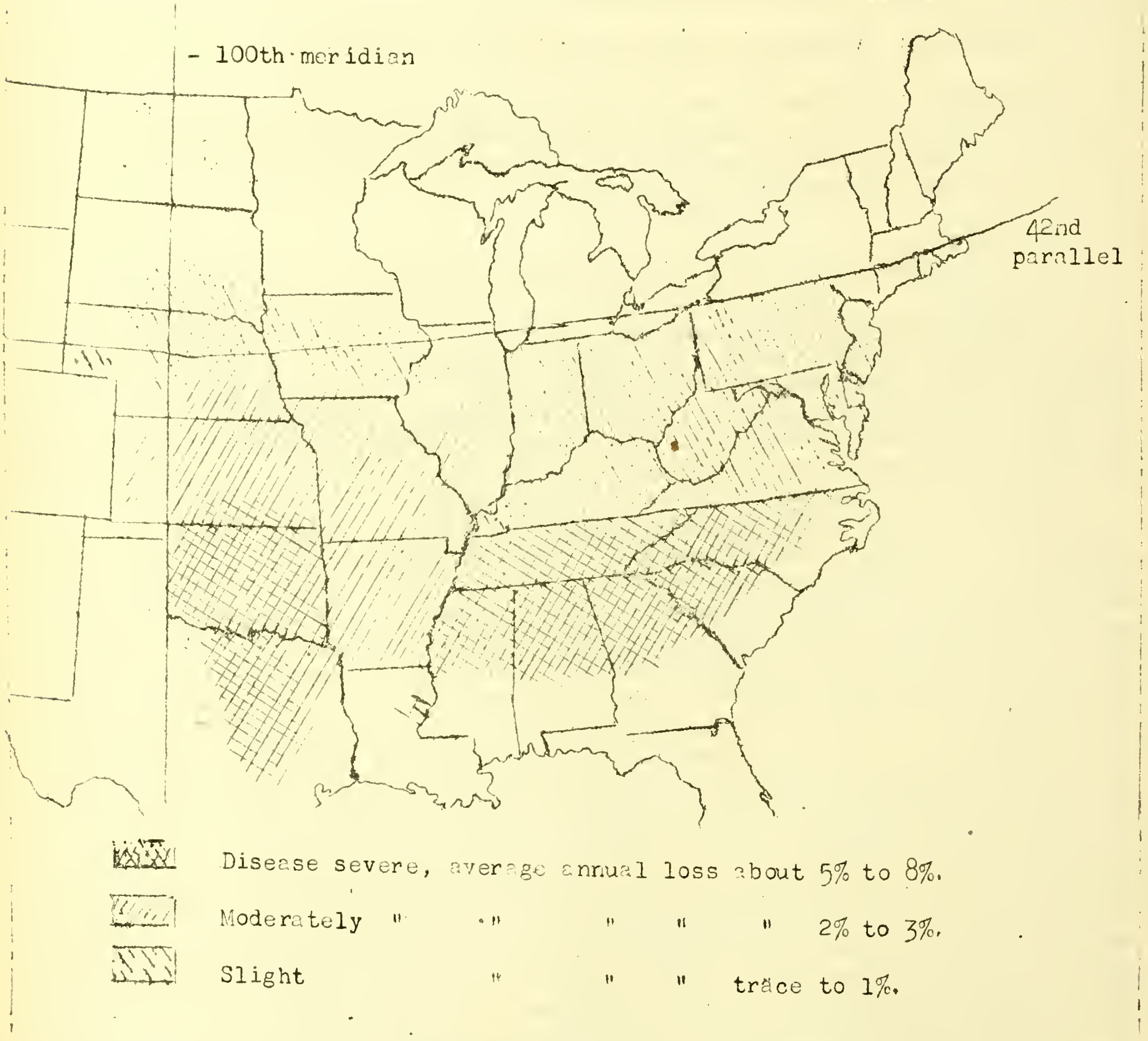

- 100th meridian
42nd parallel
▩ Disease severe, average annual loss about 5% to 8%.
▨ Moderately " " " " " 2% to 3%.
▧ Slight " " " trace to 1%.

Fig. 24. Occurrence of apple blotch in the United States.

only one county"; 1912 - "On Northwestern Greening, spreading"; 1913 - "Common wherever Northwestern Greening is cultivated"; 1919 - "Severe on some varieties southwestern part of state". Nebraska 1910 - "Seems now to be one of our new Nebraska diseases"; 1914 - "Each year becoming more widespread"; 1919 - "Estimated loss to total crop for state 2%". Kansas 1910 - "Abundant"; 1916 - "Very bad in unsprayed orchards 4 to 5% of crop lost (in such cases)"; 1918 - "One of the most destructive diseases of summer apples the past season, difficult to find fruit of early varieties not affected with blotch, loss 10 to 65% (locally)". Average loss 3% total crop for state.

While it is possible that climatic influences may not favor the serious aggression of apple blotch beyond its present northern limits, New York and New England may be interested to know that the disease is reported from at least three northern tier counties of Pennsylvania (Susquehanna - 1913, 1917; McKean - 1916, 1917, 1918; Erie - 1918), and Michigan to note that her neighbors on the south have reported it in northern tier counties as follows: Ohio, Cuyahoga - 1911, 1919; Lucas - 1914, 1916; Lake - 1916; Lorain - 1919; Indiana, Laporte - 1916. Collaborators in states like New York and Michigan should maintain a close watch for initial appearances of this disease, especially in their southern counties.

The occurrence of apple blotch in the United States, as reported to date, is therefore remarkably well defined by the area lying south of the 42nd parallel and east of the 100th meridian. At the extreme northeast of this area the disease does not occur (New York and New England) and in the extreme northwest it extends a little farther north. With the exception of the most northern portion of this area blotch is widely distributed, and on the whole very abundant. (See Fig. 24.)

Losses average around 1% in the states east of Illinois and north of Tennessee and North Carolina (only a trace in Delaware, New Jersey, and West Virginia), and are probably not over a trace to 1% in northern Iowa and South Dakota. Heaviest losses are sustained in Arkansas, Missouri, Illinois, Kansas, Oklahoma, Texas, and the states east of the Mississippi which lie south of Virginia. John W. Roberts, United States Department of Agriculture, states that apple blotch is at its worst and hardest to control in the vicinity of Wichita, Kansas.

For corrected percentage losses by states in 1919 see Plant Disease Bulletin, Supplement 12, 1920.

Table 22 shows the relative importance of blotch to the apple industry in 1919.

The greatest loss in bushels from blotch in 1919 was sustained in the states comprising group "B" (Illinois, Kansas, Nebraska, Missouri, Arkansas), where 12.1% of the total apple crop of the United States was produced, and 0.3% of it (442,000 bushels) lost from this disease. Of this group at least Arkansas and Missouri would be classed in group "A" (5 to 8% local loss) if good control measures were not employed. The eight states comprising group "A" (Oklahoma, Texas, Mississippi, Alabama, Georgia, Tennessee, North Carolina, South Carolina), while producing only one-third the quantity of apples, suffered almost as heavily in total bushels lost (412,000) as group "B". In this section blotch is very prevalent, and in many orchards control measures are not practiced. In group "C" (Pennsylvania, Maryland, Virginia, Ohio, Indiana, Kentucky, Iowa) where 18.7% of the total apple crop of 1919 was produced, and where blotch is as yet scattered but is becoming annually more serious, 280,000 bushels were lost - or more than the combined losses of Nebraska, Missouri, and Arkansas from this disease. Sixty per cent of the apple production of the country (group "E") is entirely free from apple blotch.

Table 22. Losses from apple blotch in 1919. States grouped according to prevalence of disease.

Groups of states.	Character of injury	Percentage loss of total crop for area.	Importance of industry in area % U.S. crop produced.		Percentage of total U.S. crop lost in area from blotch	Bushels lost.
			Total	Com'l		
A. Okla. Tex. Miss. Ala. Ga. Tenn. N.C. S.C (La. crop unimportant)	Severe	5% to 8%	4.6 -	1.3	0.28 +	412,000
B. (a) Ill. Kans.	Moderate	3%	4.6 -	4.6	0.15 -	221,000
(b) Nebr. Mo. Ark.	"	2%	7.5 +	9.0	0.15 +	221,000
C. Pa. Md. Va. Ohio, Ind. Ky. Iowa.	Slight	1%	18.7 +	12.5	0.19 -	280,000
D. N.J., Del. W.Va. S. D.	Trace	Less than 1%	4.6 +	5.4	Trace	----
E. 20 remaining apple-producing states.	None	0	60.0	67.2	0	0

* *

Loss to total U. S. apple crop from blotch in 1919 - - - 0.77% 1,134,000 bu.

Out of 2973 cars of apples inspected by the Bureau of Markets inspectors in 1919, at least 15 cars were found to be affected with blotch (Phyllosticta solitaria). In the following table this number is divided up according to the respective points of origin in view of the above grouping. It should be remembered that the markets inspections have only to do with commercial production, and therefore while losses from blotch are much greater locally in the states comprising group "A", for example, than from those in group "B", the latter group put more than ten times as much fruit as the former on the market.

Table 23. Losses from blotch (Phyllosticta solitaria) as shown by inspection of cars at destination by inspectors of the Bureau of Markets.

	Total number of cars.	Average percentage of fruit affected.
Group A. (severe loss)		
Texas	2	26%
Group B. (moderate loss)		
Ill. - 2 cars		
Kans. - 2 cars		
Mo. - 1 car		
Ark. - 5 cars	10	18%
Group C. (slight loss)		
Virginia	1	3%
Origin unknown	1	3%

Susceptibility of varieties in 1919 was listed as follows by collaborators. No resistant varieties were mentioned.

Susceptible

Virginia: Ben Davis
Limbertwig
Northwestern Greening
Rhode Island
Yellow Newtown

Illinois: Oldenburg (Duchess)
Ben Davis
Maiden Blush

Indiana: Northwestern Greening
Rhode Island (R.I.Greening)
Stark
Ben Davis
Smith (Smith Cider)
Oldenburg (Duchess)
Arkansas Red

Iowa: Northwestern Greening

Varieties reported affected, susceptibility not given.

Delaware: Smith (Smith Cider)
Jonathan
Fourth of July

Illinois: Grimes and Jonathan in region of heavy infection.
Transparent

The Yellow Newtown and Jonathan are generally considered resistant. J. W. Roberts states that in Arkansas the Jonathan variety is seldom sprayed for blotch.

Of the susceptible varieties the following are among the most severely attacked: Northwestern Greening, Smith, Missouri, Limbertwig, Ben Davis, Wagener, Willow, Maiden Blush.

The resistant are: Jonathan, Winesap, York Imperial.

Table 24. Susceptibility of apple varieties to blotch as reported by collaborators. Summary of reports from 1905 to 1919.

(Note: Frequently reports stated disease severe, without naming the susceptible and resistant varieties. Varieties underlined appear also in another class.)

Susceptible

Arkansas: Okla., '19

Arkansas Black:
Mo., '18
Okla., '17, '18

Arkansas Red: Ind., '19

Ben Davis:
Ill., '12, '18, '19
Ind., '19
Mo., '18
Nebr., '18
Okla. '17, '18, '19
Va., '18, '19

Bentley (Bentley Sweet):
Ohio

Black Twig: Pa., '17
Okla., '19

Colton (Early Colton):
Mo., '18

Cornell.

Delicious: Nebr., '18
(One report)

Early Cooper (Cooper's Early White):
Nebr., '18

Early Harvest: Mo., '18

Ewalt: Pa., '11

Gano: Okla., '17, '18, '19

Grimes (Grimes Golden):
Ohio, '14, '15, '16
Pa., '17

Krauser: Pa., '11

Limbertwig (Red Limbertwig):
N.C., '12, '15
Ohio, '18
Va., '19

Maiden Blush:
Ill., '19
Mo., '18, '19
Pa., '11, '18, '19

Mann: Ohio, '16, '18

Missouri (Missouri Pippin):
Ill., '12
Mo., '17, '19
Ohio, '18
Okla., '19

Northwestern Greening:
Ind., '19
Iowa, '12, '13, '19
Mo., '17, '18
Ohio, '15, '16, '18
Pa., '19
Va., '19

Oldenburg (Duchess):
Ind., '19
Ill., '19
Ohio, '18

Ralls (Genett) Nebr. "18

Red Astrachan: Va., '08

Rhode Island (Rhode Island Greening
Ind., '19
Va., '19

Rome (Rome Beauty):
Ill., '12
N. C., '12

Smith (Smith Cider):
Del., '10, '19
Ind., '19
Mo., '05
N. J., '15, '16, '17, '18
Ohio, '14, '15, '16, '18
Pa., '11, '17, '18, '19

Stark:
Ind., '19
Ohio, '14, '16, '18
Pa., '11, '17, '18

Summer Rambo:
Ohio, '16

Wealthy: Mo., '18

White Pippin:
Mo., '18

Yellow Newtown:
Va., '19

Yellow Transparent:
Mo., '18

Wagener:
Ohio: '14, '15

Willow (Willow Twig):
Ind., "12
W. Va., 07.

Resistant

Baldwin: Ohio

Gano: Ohio "Less susceptible", (Bul. 333)

Grimes (Grimes Golden): Ohio, '18
"Less susceptible", (Bul. 333)

Jonathan: Okla., '17, '19
Ohio, (Bul. 333)

Milam: Mo., '18

Maiden Blush: Ohio, "Less susceptible", (Bul. 333)

Rhode Island (R. I. Greening); Ohio, (Bul, 333)

Rome (Rome Beauty): Ohio, '18

Stayman Winesap: Ohio, (Bul. 333)

Wagener: Pa., '11

Wealthy: Pa., '11

Winesap:
Mo., '18
Okla., '17, '18
Ohio, (Bul. 333)

York Imperial:
Va., '18
Ohio, (Bul. 333)

Reported on, susceptibility not given

Ben Davis: Pa., '19

Colton (Early Colton): Mo., '17

Fourth of July: Del., '19

Gano: Mo., '19

Grimes (Grimes Golden): Ill., '19

Jonathan: Del., '19
Ill., '19
Mo., '19

McMahon: Mo. '19

Rambo: Ohio

Roman Stem: N. J., '18

Yellow Transparent:
Ill., '19
Mo., '19

York Imperial: Pa., '19

Spraying with Bordeaux when properly applied seems to have given good results in 1919.

Results of spraying are reported by states as follows:

Arkansas: "Bordeaux good."

Georgia: "Thorough spraying protected the fruit."

Illinois: "Lime sulphur and Bordeaux gave good results, properly applied."

Indiana: "Bordeaux fairly successful, dust gave only a slight degree of control."

Missouri: "Spraying sometimes quite effective, in other cases results unsatisfactory."

Ohio: "Spraying Clermont County orchards in 1918 at three weeks' intervals following petal fall gave less than 50 per cent marketable fruit. Three applications of Bordeaux mixture in 1919 in several counties at intervals of two weeks, followed by an additional application in July, gave an average of over 90 per cent marketable fruit. Unsprayed trees in the same orchards gave less than 10 per cent marketable fruit in blotch areas. Sprayed trees bore more fruit and their apples were larger as a rule than those from unsprayed trees. No trees were sprayed on the three-weeks schedule in these trials." (Stover, Beach, Parks) (Abstracts - St. Louis Meeting).

Oklahoma: "Bordeaux gave fair to good control."

Tennessee: "It is controlled by spraying." (Essary)

Virginia: "Bordeaux 3 weeks after bloom fell gave good results. Bordeaux used for calyx spray gave excellent control, according to report, but russeted fruit. Bordeaux dust in experimental work gave most excellent results."

John W. Roberts, Fruit Disease Investigations, United States Department of Agriculture, recommends the following: Bordeaux, 3-4-50. The first spraying for this disease is the most important and should be finished three weeks after the petals have fallen. The second and third applications should follow at three weeks intervals. Roberts believes that 90% of the 1,134,000 bushels loss (see Table 22) could have been prevented by spraying.

Rust caused by Gymnosporangium juniperi-virginianae Schw.

Apple rust is distributed over the Atlantic States from Maine to Georgia, and extends westward as far as the outer boundaries of the non-irrigated apple belt. Extensive commercial production over this half of the country ceases at about the line of 18 inches annual precipitation, but rust is reported from scattered plantings practically up to the 100th meridian (see map). Collaborator J. G. Leach stated that through an error the disease was reported from Colorado in 1918. It is not found in the irrigated districts, nor in the humid regions of the Pacific Coast.

According to Charles Mohr, United States Department of Agriculture, (Division of Forestry, Bul. 31, 1901) the red cedar of the East, Juniperus virginiana, which serves as the alternate host for the apple rust fungus, is one of the most widely distributed and one of the most indifferent to soil and climate of any tree in the eastern half of the country.

> "Its northern limit on the Atlantic Coast is in southern Nova Scotia, and in the interior on Lake Champlain. Toward the west the tree extends under nearly the same parallel (44° to 44° 30' N.) to the southern shore of Georgian Bay, to Northern Michigan, southern South Dakota, western Nebraska, and Kansas, and southward to the eastern bank of the Colorado River, near Austin in southeastern Texas. It thrives in the valley of the St. Lawrence and in New

England; on the hills and limestone flats of the Southern States; and on the exposed arid ridges of Kansas and Nebraska. It is, however, south of the 36th parallel that the red cedar is at its best.

"As has been shown by Prof. C. S. Sargent, the red cedar of the West, formerly considered identical with that of the East, is a distinct species, for which he proposed the name *Juniperus scopulorum*. *Juniperus virginiana* does not extend farther west than the basin of the Mississippi River in the North, and the eastern slope of the Colorado River Valley (eastern Texas) in the south."

The red cedar of the Gulf shore and eastern Florida is a distinct species - *Juniperus barbadensis*, so that the southern limits of *Juniperus virginiana* are probably "on the coast in lower South Carolina, and westward on the limestone hills in the upper division of the maritime pine belt in Alabama and Mississippi."

The relative prevalence of the apple rust fungus in the eastern half of the United States is very variable, depending upon distribution of cedars, introduction of the fungus, susceptible varieties of apple, and climate.

The more prominent regions may be grouped as follows:

Group I. Large percentage losses to total crop.

(a) Virginia : Often a loss of perhaps 6 to 8% of the
North Carolina: total crop for these states.

(b) Tennessee :
Arkansas : Average losses probably not far from 2 to 3%
South Carolina:

Group II. Average losses to the total crop for the state in excess of a trace, but generally only moderate, perhaps 1% ordinarily.

(a) South Central Pennsylvania, Maryland, West Virginia (percentage higher in the Panhandle), Ohio River Valley.

(b) Southern Wisconsin, Minnesota.

(c) Western Iowa, Eastern Nebraska, Southeastern South Dakota.

(d) Northern parts of Georgia, Alabama, and Mississippi.

Group III. Rust occurs only locally, is in most cases only present and seldom causes more than a trace of damage.

(a) New England, very slight infection, occasionally prominent locally in Massachusetts.

(b) New York - Cedars are scattered over New York, but rust seems to be more common in the lower Hudson River Valley and in Central Long Island, where it may cause local losses of less than 1%.

(c) New Jersey - With New York in occasional slight local losses.

(d) Delaware - With New York in occasional slight local losses.

(e) Michigan - "Frequently in Michigan cedars and apples may be found growing in close proximity, but cedar rust is very rare, it is probably a question of the fungus not having been introduced." (Bessey)

(f) Missouri - Less than 1%; not at all serious.

(g) North Dakota, Kansas, Oklahoma, and Texas - No appreciable injury; disease merely present.

Group IV. States where apple rust is not reported to occur: Florida and all territory west of the 100th meridian.

The above estimates are an approximation only of the losses from apple rust based on reports covering the period 1903-1919. Figure 25 indicates in a general way the distribution and relative importance of the disease in the various states where it occurs.

Apple rust in 1919.

In 1919 apple rust occurred throughout the region of its usual distribution (outlined above) and was reported from no new localities. Reports from the Pacific Coast state that it does not occur there.

Continued rainfall prevailed over much of the eastern country during the spring and early summer, which greatly favored extensive infection of the young leaves in the regions where gall-bearing cedars are found in the vicinity of orchards. Heavy defoliation followed, which in some sections materially reduced the size of the crop.

The region in which heaviest losses were sustained in 1919 from apple rust includes: South Central Pennsylvania, the Panhandle of West Virginia, the Shenandoah Valley and Southwestern Virginia, North Carolina, Tennessee, and Arkansas. Virginia leads this group with a loss of 15% (valued at $1,500,000) to the total crop for the state. Fromme stated:

> "Greater loss than in any previous year - unusually favorable season for infection, few leaves escaped in exposed orchards. Late summer drought added to losses in further reducing size of fruit. No Yorks large enough for barreling in many orchards, largely sold for bulk or cider stock."

North Carolina reported 10% loss; Pennsylvania, West Virginia, Tennessee, South Carolina, and Arkansas sustained losses which they characterized as "severe" in localities, and which probably ran from 1% to 3% of the total crop. The northern parts of South Carolina, Georgia, Alabama, and Mississippi indicate considerable loss, although percentage losses are probably not above 1%. Apple rust in Eastern Nebraska and Southeastern Minnesota was important in 1919, causing its usual annual loss of from 1 to 2% of the crop.

Ohio, Indiana, Illinois, Missouri, and Iowa reported less damage than usual, amounting to about 1% in Ohio and not much more than a trace in the other states.

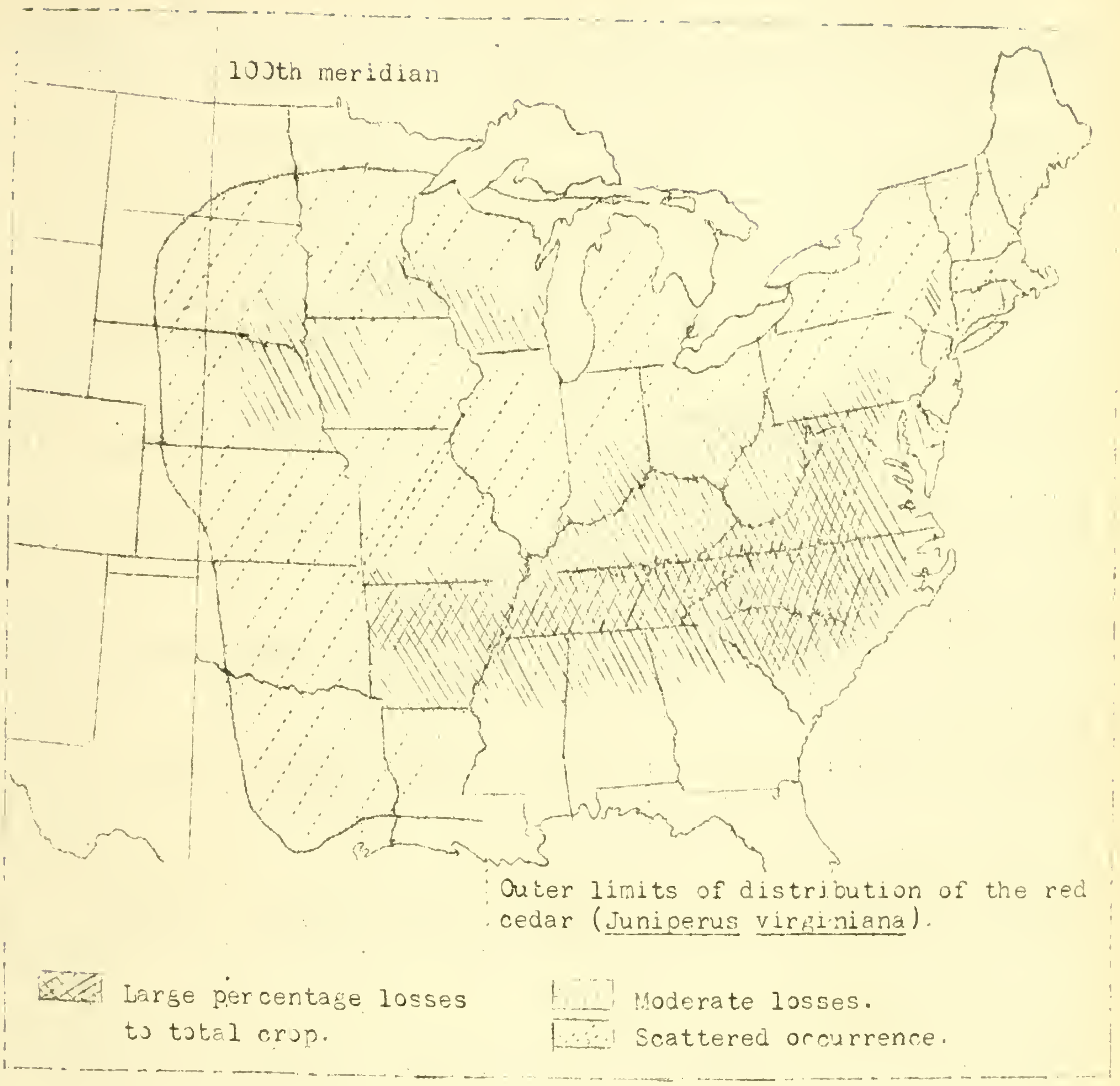

100th meridian
Outer limits of distribution of the red cedar (*Juniperus virginiana*).
▨ Large percentage losses to total crop.
▨ Moderate losses.
▨ Scattered occurrence.

Fig. 25. Occurrence of apple rust in the United States.

M. B. Waite, United States Department of Agriculture, commented as follows upon the occurrence of apple rust in 1919:

> "From personal observations, conversation with fruit growers, and reports by correspondence, apple cedar rust has been considerably worse than usual during the past season in the Appalachian Fruit Belt, including parts of Pennsylvania, Maryland, Virginia, West Virginia, and North Carolina. The disease is evidently on the increase, as it has been in these districts since 1908 when it became notably serious on the York Imperial in spots.
>
> "In addition to the increase in the amount of infection, the unusual weather conditions of last spring, the excessive number of rainy and cloudy days occurring last spring, are undoubtedly an important factor in this outbreak. (See further under apple scab)."

For corrected percentage losses by states see Plant Disease Bulletin, Supplement 12, 1920. The following table is intended to give at a glance a general idea of the importance of rust to the apple industry for 1919.

Table 25. Summary of losses in the United States from apple rust, 1919.

Groups	Character of injury	Approximate percentage loss of total crop for area	Percentage of U. S. apple crop produced in area 1919		Percentage of total U. S. crop lost in this area from rust in 1919	
			Total	Com'l	Percent	Bushels
A. (a) Va.	Very severe	15	6.74	5.76	1	1,474,000
(b) N. Car.	" "	10	0.75	0.35	0.075	110,000
B. Pa., W. Va., Ky., Tenn., S. Car., Ark., & Nebr.	Severe	2	13.95	16.75	0.28	412,000
C. Md., Ohio, Ga., Ala., Minn., & Miss	Moderate	1	5.	2.74	0.05	73,000
D. Mass., N.Y., N.J. Del., Ind., Ill., Wis., Mo., S. Dak., & Iowa.	Trace	Less than 1	26.94	26.70	Trace	
E. Me., Vt., Conn., R.I., Mich., N. Dak. Kan., Okla., Tex., La., & Colo.	Rare	Negligible	14.86	13.09	Negligible	
F. Wash., Ore., Calif. Ida., Mont., Wyo., Utah, Nev., N. Mex., & Ariz.	Disease not known to occur	0	31.75	34.61	0	
United States					1.4%	2,064,000

It therefore appears that about 1.4% of the total apple crop of the country for 1919 or roughly 2,000,000 bushels was lost from rust, and that three-quarters of this loss occurred in Virginia alone.

Summary of distribution of losses, from data in preceding table.

Apple production in 1919	Losses from apple rust
21% (Groups A & B)	Heavy - 1.35%
5% (Group C)	Moderate - 0.05%
27% (Group D)	Trace - t
47% (Groups E & F)	No loss - 0

Dates of first appearance in 1919, collaborators' reports

May 22	Minn.	June 1	Iowa
May 28	Ind.	June 5	Tenn.
May 28	Va.	June 14	Pa.
May --	Ark.	June 15	S. C.
May --	Okla	June 26	Mo.

Growing resistant varieties is manifestly a considerable factor in control.

Table 26. Susceptibility of varieties as given by collaborators, 1919

States	Susceptible	Moderate	Resistant
Arkansas	Jonathan	–	Winesap
	Ben Davis	–	–
Minnesota	Wealthy	–	Patten's Greening
			Northwestern Greening
Pennsylvania	York Imperial	–	–
Wisconsin	Wealthy	–	–
Virginia	York	Ben Davis	Winesap
	Rome Beauty	Northern Spy	Red June
	Shockley	Limbertwig	M. Black Twig
	Gravenstein	Fallawater	Stayman
	Missouri Pippin	Gano	Delicious
	Willow Twig	Lowry	Grimes
	Duchess		Virginia Beauty
	Jonathan		King David
			Baldwin

NOTE: Non-bearing trees suffer more injury to foliage than bearing trees.

Table 27. SUMMARY: of survey data from 1905 to 1919 on susceptibility of apple varieties to rust as reported by collaborators.

(Names underscored appear also in another column.)

Susceptible	Moderate	Resistant
Ben Davis: Ark. '19, Ia. '18, N.C. '12, Ohio '17, Pa. '17, Tenn. '12, Va. '13, '18	Banana: N. C. '12	Arkansas: Tenn.
	Ben Davis: Va. '19	Baldwin: Va. '19
		Black Twig: Va. '13, '18, '19
Early Harvest: Tenn.		Buckingham: N.C. '12.

Susceptible	Moderate	Resistant
Fallawater: N.C. '12, Pa. '11	Fallawater: Va. '19	Delicious: Va. '18, '19
Gravenstein: Va. '19	Gano: Va. '19	
Grimes Golden: S.C. '10		Grimes Golden: Va. '13, '19
		Hibernal: Minn.
Jonathan: Colo. Mo. '15, '17, '18 Ohio '17, Pa. '11 Va. '13, '19	Jonathan: N. Y. '17	King David: Va. '19
	Limbertwig: Va. '19	Maiden Blush: Colo.
	Lowry: Va. '19	
King: N. Y. '17		Northwestern Greening: Va. '13, W. Va. '17
Lowell: Ohio '17		Okabena: Minn.
Missouri Pippin: Va. '19		Oldenburg: Minn.
Northern Spy: Va. '09	Northern Spy: Va. '19	
Oldenburg (Duchess): Va. '19		
Paradise Sweet: Va. '09		
Pound: Pa. '11		
Rambo: Pa. '11, '17		
Red June: S. C. '10	Red June: N.C. '12	Red June: Va. '19
Rome: Ind. '16 Mo. '15, '17, '18 N.Y. '17, N.C. '12		Stayman Winesap: N.C. '12 Pa. '11, '17 Va. '13, '18, '19
Shockley: N.C. '12, S.C. '10, Va. '19		
Virginia Beauty: Va. '19		
Wagner: Pa. '11		Winesap: Colo. N.C. '12, Ohio '17 Va. '13, '18, '19 W. Va. '17
Wealthy: Iowa '18, N.J. '18 N.Y. '17, '18, Ohio '17 Minn. S.D. '05, '17 W. Va. '15, Wis. '18		
Willow: Va. '19		Yellow Transparent: Pa. '17 (entirely free)
York Imperial: N.Y. '13 Pa. '11, '17, '19 Va. '09, '13, '18, '19 W. Va. '17		

Varieties reported affected - resistance not given.

Bellflower..........N. Y., '19
Hubbardston.........N. Y., '18
Opalescent..........N. Y., '18
Twenty Ounce........N. Y., '18
Wealthy.........Conn., '18
Banana..........N. Y., '18
York Imperial...N. Y., '18

The universally accepted control of apple rust is the eradication of the alternate host in the vicinity of orchards. Eradication of all cedars within one mile has generally given good results, but recent experience with the disease in Virginia and West Virginia under most favorable conditions for its development, indicate that safety demands a cedar-free zone of a somewhat larger extent. Regarding this subject M. B. Waite, Office of Fruit Disease Investigations, has furnished the following paragraphs:

> "While the Department of Agriculture has been advising the cutting of red cedars for years, in fact since 1888, long before the disease became generally serious and while the experiment stations in these and other states have been urging the eradication of the red cedars, in only certain communities and around certain orchards has this been thoroughly done. The distance necessary for success in eradicating the cedars may be regarded as somewhat of an open question. The experience of the last season in Virginia in this unusual outbreak rather plainly shows that the distance of one mile is not fully effective, where large numbers of cedar trees are involved.
>
> "The first attempts to eradicate the cedars in Virginia and West Virginia, which was quite successful, indicated that one mile, or frequently one-half mile, was sufficient. It is certainly true that the most important cedars to cut are the infected trees nearest to the apples, but it also appears that large numbers of infected cedars even one mile away are dangerous. The Virginia State Law is drawn to enforce cedar eradication for a distance of one mile. A distance of two miles has been suggested as probably effective, but since the difficulties increased and the matter was not well settled at that time, the Virginia growers accepted one mile as probably satisfactory, and we were inclined to agree with them. It appears now that the large commercial orchards are quite likely to suffer unless these dangerous cedars are removed for more than one mile.
>
> "This is interesting from another standpoint which has been considered; namely, that the cedars to be dangerous must in turn be infected from the apple orchards. Undoubtedly, however, small orchards or a few non-commercial trees in home orchards at a closer distance than the main blocks may serve for reinfecting the cedars."

In reply to a questionnaire concerning the progress of cedar eradication collaborators reported as follows:

Virginia: "Cedar cutting clubs are being formed (several counties) and a concerted effort for county-wide eradication of cedars will be put forth this winter. The State Horticultural Society is asking the Legislature to amend the Cedar Rust Law, making it mandatory, and to extend limits of cedars to two miles from apple orchards. Effectiveness of thorough cedar removal was shown by survey of 150 orchards in Augusta county. Severity of disease varied with location, number, size, and exposure of cedars. Orchards in one locality where thorough eradication had been accomplished were practically free from rust and produced good crops of apples." (Fromme)

West Virginia: "We have secured cedar free areas of considerable extent around all the more important commercial orchards in the eastern part of the state. The amount of cedar destruction has really been tremendous and I feel that we have accomplished results of inestimable value. It is a result of cooperation between orchard men, the county as a whole, the Commissioner of Agriculture and the department of plant pathology. I believe that we have saved the growers in the eastern part of the state millions of dollars." (Giddings) Also reported having planted a large orchard in a tract where cedar rust will continue to be abundant, for testing resistance of varieties.

Tennessee: "No move as yet to eradicate cedars. Few cedars in the Cumberland, where fruit growing could be carried on successfully." (Essary) Essary has also stated that in Central Tennessee the red cedar is itself grown commercially, which of course precludes an apple industry of less importance than the cedar.

Arkansas: "The State Plant Board has declared cedar trees a public nuisance in the better apple growing sections, and expects to completely eradicate them in those sections within a year. Public sentiment is back of the movement." (Elliott).

Ohio: "Cedar trees very abundant in southern half of state. The disease is worst in this area where apple orchards are extensive. Progress of eradication is at a standstill." (Selby)

Minnesota: "Cedars are abundant in many parts of the state. Rust is most serious in southeastern portion. Many farms have ceased raising apples in this region, due particularly to rust and scab." (Bisby) (No eradication reported).

Michigan: No rust losses yet reported. Cedars scarce. Cedars and apples grow in proximity in some places without trouble. Believe the organism restricted in distribution.

Colorado: The cedar rust situation in Colorado is not serious. No eradications have been undertaken.

Pennsylvania: "Cedar rust most prevalent in southeast section of Pennsylvania, especially Cumberland Valley. No eradication campaign yet initiated. Under consideration by Sanders and McCubbin." (C. R. Orton)

A detailed survey of the cedar rust situation was made in Augusta County, Virginia by Marshall and Fromme and reported by them in Ext. Div. Va. A. & M. Col. and Polytech. Inst. Bul. 39 : 1-8, 1920. The following data taken from their tabulations show strikingly the relation of the proximity of cedars to losses of the apple crop from rust.

Table 28. Condensed summary: Relation of cedar rust infection of apple to (1) number and proximity of cedar trees, (2) average yeild in barrels per tree, (3) grades, and (4) returns.

Relative number of cedars within 1 mile	Number orchards	No. York Imperial trees	Av. yield per tree in bbl.	Relation to grades			Value per tree	Return per acre
				No. 1's	No. 2's	Culls		
Very few	4	3,200	2.66	67.2%	7.5%	25.3%	$11.57	$497.51
Few	13	12,340	1.53	47.9%	24.7%	27.4%	6.29	270.47
Many	13	12,330	.94	23.3%	32.5%	44.2%	3.27	140.61
Very many	9	9,115	.52	1.7%	6.3%	92.0%	1.11	72.15

Spraying has been frequently reported of value. Giddings (W. Va.) reported it "successful" in 1912, 1913, and 1914. In 1915 he found it "ineffective". Selby (Ohio) in 1919 reported: "Same spray as for blotch good." The extended period over which infection is possible, the rapid growth of leaves during this period, producing new surfaces continuously, and the frequent difficulty of applying fungicides owing to the weather conditions which favor infection, help to make this method of control often impracticable.

Black rot caused by *Physalospora cydoniae* Arnaud (*Sphaeropsis malorum* (Berk.) Pk.)

Black rot was reported by collaborators in 1919 from practically all apple growing regions in the eastern half of the United States, and also from Colorado and New Mexico. Greatest loss from this disease occurred in the states which lie east of the Mississippi and south of the Ohio and Potomac Rivers. Georgia reported 10% loss, North Carolina 8%, Tennessee 5%, West Virginia 5%, and Virginia 3%. North of the Ohio River, Illinois estimated losses at 0.2%, Indiana 1%, Ohio 2%, and Pennsylvania 3-4%. New York reported the disease general but only locally severe, particularly in Monroe and Wayne Counties. New Jersey, Delaware, and Maryland suffered unusual losses. In New England it was reported as scarce, in New Hampshire mostly affecting small summer varieties, and was the cause of large losses in Vermont, Massachusetts, and Connecticut.

West of the Mississippi black rot was distributed generally over the non-irrigated apple districts, and was reported also common in Colorado and New Mexico. Its prevalence in the Northwest and on the Pacific Coast was not reported. Arkansas reported much less severe than last year, causing 0.5% loss. In Missouri it was common, causing more damage than bitter rot. Oklahoma reported it causing one-half as much damage as apple blotch, and next to blotch in importance in that state. Texas reported 1% loss. Cankers were abundant in Colorado. In New Mexico black rot caused 90% loss in some neglected orchards, particularly old trees suffering from want of irrigation and pruning, but it was generally slight in well cared for orchards.

Leaf injury was mentioned as being particularly severe in Massachusetts, Delaware, Maryland, West Virginia, Virginia, (Fromme stated: "Frog eye spot found this year in practically every orchard visited, somewhat less in the Shenandoah Valley than in other sections. It appeared unusually early. In many orchards 50-60% defoliation had resulted by July 15.), Mississippi, Illinois, Iowa (leaves of all varieties), Kansas, and Arkansas (foliage infection very general).

Fruit infection was especially mentioned in Pennsylvania (blossom end rot common, especially on Ben Davis), West Virginia, Illinois (blossom end rot common), Michigan (black rot of fruit on trees unusually common), and New Jersey (most common orchard rot in state).

Cankers were reported serious in Mississippi and Colorado.

Losses caused by black rot to apples in transit in 1919 were reported by Bureau of Markets inspectors as given in Table 29.

First reports of black rot in 1919 were received as follows:

April 21 - Virginia
May 15 - Tennessee
May 20 - Missouri
May 25 - Pennsylvania
May 28 - Indiana
June 6 - Connecticut
June 9 - New Hampshire
June 10 - Arkansas (1st rotted fruit, Red Astrachan)
June 11 - Iowa
June 23 - Minnesota (leaf)
July 10 - Illinois

The Paragon variety (Mammoth Black Twig) was mentioned as particularly susceptible in Virginia.

Table 29. Losses from black rot as shown by inspection of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	No. of cars with infection	Average percentage of infection	Range of percentage of infection	Remarks as to seriousness of decay.
Arkansas	13	11	2-28%	Most decay occurs in spots.
California	1	6	6%	Slight decay.
Colorado	4	10	2-25%	Mostly slight decay; blue mold rot noted in some cars.
Illinois	9	42	3 cars- 80-95%	Very heavy decay. Other decays noted.
			4 cars- 2-18%	Mostly slight decay.
			2 cars- 35-40%	Heavy decay, other decays present.
Kansas	1	2	2%	Slight decay.
Maine	1	30	10-50%	Some complete decay; blue mold rot also present.
Maryland	6	8	2-13%	Mostly slight decay
Massachusetts	2	4	2-6%	Slight decay.
Michigan	10	7	2-18%	Some complete decay, mostly slight.
Minnesota	1	3	2-4%	Slight decay.
Missouri	7	9	3-25%	Mostly slight decay.
New York	1	3	3%	Slight decay accompanied by blue mold rot.
Ohio	2	10	3-17%	Slight decay accompanied by other decays.
Oregon	1	11	11%	
Pennsylvania	2	9	3-15%	Slight decay, accompanied by blue mold in one car.
Texas	1	2	2%	Slight decay.
Virginia	36	11	4 cars- 25-50%	Heavy decay.
			32 cars- 2-24%	Some complete decay, but mostly slight.
Washington	5	11	2-20%	Other decays also present.
West Virginia	13	11	2-39%	Other decays also present.
Unknown	3	12	2-30%	Decay usually in spots.
Total	119	Total number of cars inspected - 2973.		

Control of black rot was reported as follows by collaborators in 1919:

Ohio: (Selby) Pruning and copper spray in July effective.

West Virginia: (Giddings) Spray more effective than dust.

Virginia: (Fromme) "Lime-sulphur 2-3 weeks after codling moth spray gives satisfactory control. The effect of fertilization was evident in one orchard. A strip having nitrate of soda, 3 to 4 lbs. per tree, was almost free from injury, while other portions had a great deal."

Fire blight caused by *Bacillus amylovorous* (Burr.) Trevisan

Fire blight occurred in 1919 in practically all states where the apple and pear are grown, but for the most part is perhaps the lightest infection of recent years. The group of states lying south of the Ohio and east of the Mississippi, excepting Virginia and West Virginia, constitutes the only area reporting very severe losses to the apple crop from the disease in 1919. Losses in this area ran about as follows: North Carolina, 10%; South Carolina, 10%; Georgia, 12%; Alabama, 5%; Mississippi, 5%; Tennessee, 5%; Kentucky, 2%. Other states in the eastern half of the country estimated losses as follows: Texas, 2%; Arkansas, Missouri, Kansas, Minnesota, Wisconsin, New Jersey, Pennsylvania, and West Virginia, 1%; in Virginia, Delaware, Maryland, Ohio, and Indiana losses were about 0.5%; New England, New York, Michigan, Illinois, Iowa, North Dakota, Nebraska, and Oklahoma report only a trace of injury from fire blight in 1919. While common on pear, it was reported as rare on apple in Michigan.

Of the western states (west of the 100th meridian), Idaho and Oregon reported losses of 1% in 1919; Colorado stated, "disease very prevalent, usual amount of damage", but gave no estimate of loss; Washington, Montana, and New Mexico reported a trace; and Arizona reported that annually 1/2% of the acreage is lost from this disease. California did not report.

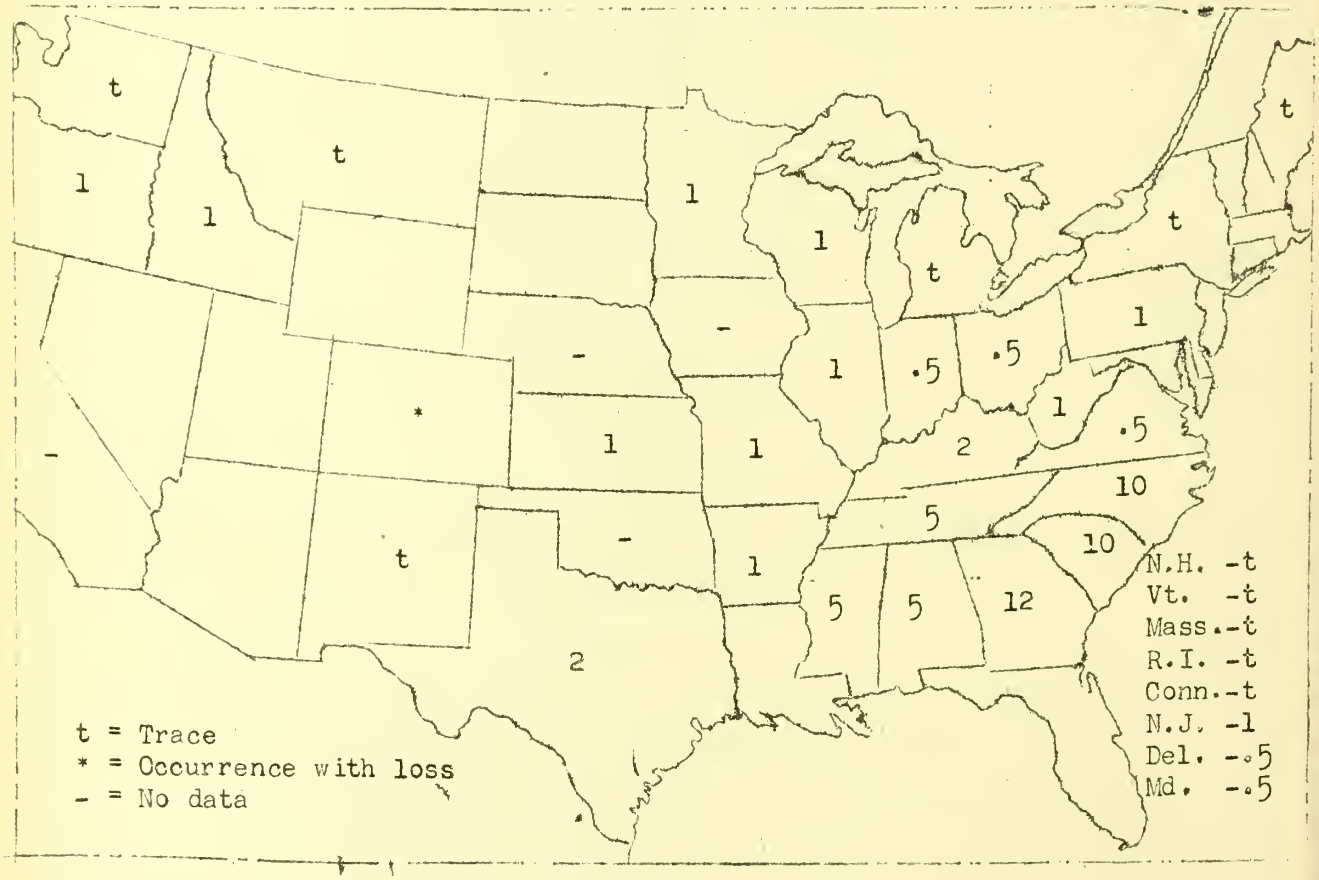


Fig. 26. Occurrence of fire blight (collar blight form generally not included) on apple in 1919.

These losses are understood to result largely from twig and blossom blight. Certain large losses from destruction of trees by collar blight would be very hard to estimate and are not included. Based upon production figures published by the Bureau of Crop Estimates and the percentages given above, losses to the 1919 apple crop of the United States from fire blight were probably over one million bushels, or, roughly, at least 0.7%. About one-half of this loss occurred in the southeastern states from Texas to North Carolina; about one-fourth of it New Jersey, Pennsylvania, West Virginia, Missouri, Arkansas, Kansas, Wisconsin, Minnesota, Idaho, and Oregon, and approximately one-fourth of it in Virginia, Delaware, Maryland, Ohio, and Indiana.

M. B. Waite, United States Department of Agriculture, comments as follows upon the occurrence of blight on pear and apples:

> "Pear blight was much less abundant over most of the eastern United States than it has been for several years past. The great outbreak of 1914 has been greatly diminishing, until this year in general there has been less pear blight in humid eastern United States than probably at any time previous to 1912. The last outbreak previous to 1912 in the Appalachian Fruit Belt and adjacent Piedmont Coastal Plain occurred about 1900-1902. York Imperial apple trees were badly blighted in the tops at that time and blossom blight was abundant on a great variety of apples, including the Winesap and Stayman Winesap, York Imperial, and even the Ben Davis among winter varieties, and especially the Transparent, Fourth of July, Red Astrachan, Early Harvest, Red June, and others among summer varieties. From 1900 to 1902, at least during certain of those years, the blossom blight and twig blight of the apple was so abundant that in traveling through parts of Maryland and Pennsylvania, the brown scorched tree-tips were plainly visible from the train.
>
> "Referring again to the 1914 outbreak, this began to be serious in 1912. It increased during 1913 and reached its climax during 1914. From that year on, it has gradually receded until during the present season it may be regarded as distinctly sub-normal."

The collar blight form of fire blight in the apple is reported upon by several states in 1919. Manns and LeCato (Delaware) reported considerable "collar rot" in apple orchards in Kent County and stated:

> This rot is due to 2 to 3 years of very severe fire blight, 1913-1917 inclusive being years when the disease was quite severe. The troubles seem to gain entrance to the collar through lesions caused by winter injury on the south and southwestern side of the tree trunks. At the time of ascension of sap these cracked areas in the lesions permit insects to visit the oozing trees carrying bacterial infection to the trunk. The organism then goes up and down infesting the roots under the ground and completely killing all the cambium around the roots."

Arkansas (Elliott) reported, "Loss of some Transparent trees every year from collar blight." Idaho (Hungerford) reported, "What appears to have been a very severe attack of collar blight and root rot about 5 years ago has killed a large percentage of trees in the Boise Valley and adjacent regions. Reports are rather hard to follow, but it appears to have been blight."

Concerning "collar rot" Hungerford stated further:

> "This trouble is very common in Southern Idaho and has recently been reported from Post Falls, between Spokane and Coeur de 'Alene. It is especially severe upon Wagener and Jonathan, The Rome and Delicious seem to be fairly resistant. It is our opinion that the condition is brought about by winter injury, followed by fire blight in some cases."

The collar disease situation in the apple districts of Idaho was called to the attention of the Office of Fruit Disease Investigations, United States Department of Agriculture, in 1916. The organism of pear blight was isolated from the infected collar of a tree specimen sent in, and in June, 1917, the writer (Hutchins) made an investigation in the field, in which a large number of orchards from Boise to Weiser and several at Lewiston were visited. At the time these collar cases were observed collar blight (B. amylovorus) was found to be taking a heavy toll of trees, and evidently the direct cause of the majority of collar-diseased trees. This great epidemic followed closely a severe outbreak of top blight, in which eradication had been neglected. Blighted twigs, limbs, and bodies were generally present, and collar cases were, when fresh, frequently traceable to infected shoots and suckers through which the organism had gained entrance to the root, collar, or body. This district was again visited by the writer (Hutchins) in November, 1919, and while both collar and top blight were still present, the severity was scarcely a circumstance to the situation in 1917. The organism was at this time again isolated from the collars of Grimes and Jonathan trees and kept in pure culture until April (1920), when it was inoculated into the blossoms of Keiffer pear at the Department Experimental Farm, Arlington, Virginia, and produced typical blossom blight (B. amylovorus).

Several investigators have observed collar blight to be one of the important collar diseases in central irrigated districts of Washington.

Referring to collar blight (B. amylovorus), M. B. Waite, United States Department of Agriculture, makes the following statement:

> "This form of the disease (see pear) was found in considerable abundance on the apple at Montrose and Delta, Colorado, in 1904. It was later, in 1907, found in Utah in moderate abundance. It occurred occasionally along with the similar form on the pear in the Sacramento Valley of California in 1905-06 and '07. In 1906 numerous cases were found on Sptizenburg apples at Payette, Idaho. It was looked for but not found at Hood River, Oregon. In the summer of 1907, it was found abundant in the orchards of D. M. Wertz, at Quincy, Pa., and during this and subsequent years, was found abundant on Grimes in the Shenandoah Valley of Virginia and West Virginia."

The following varieties in 1919 were reported as most susceptible to blight:

Crab-apples - Iowa, Minn., Wis.
Grimes - Arkansas.
Jonathan - Ala., Ark., Ida., Ill.
Okabena - Minnesota
Yellow Newtown - Virginia
Esopus - Idaho, Oregon
Transparent - Ark., Ill.
Wealthy - Wisconsin
Banana - Indiana

It was reported as severely attacking the wild hawthorne in Wisconsin.

Powdery mildew caused by Podosphaera leucotricha (E. & E.) Salm.

Apple powdery mildew occurs from coast to coast and from the northern to the southern boundaries of the apple belt.

East of the Rocky Mountains this disease is most often reported serious in nurseries and occasionally on young orchard trees. It seldom causes much loss in bearing orchards, is considered controllable, and is, in general, not of great importance to the eastern apple industry as a whole. Losses over this area were slight in 1919. West Virginia reported a large number of trees injured, with slight loss; New York, Pennsylvania (on Gravenstein), and Ohio reported scattered local occurrence. It appeared locally also in South Carolina, with no loss, and was observed on nursery stock in Mississippi.

In certain Pacific Coast districts powdery mildew has long been a serious disease of the apple, not only affecting young trees in orchards and nurseries, but severely attacking bearing orchards, reducing the vitality of the trees, influencing the setting of fruit, and causing great loss from reduction in market grades owing to mildew markings on the fruit.

Oregon reported the disease abundant, especially in young unsprayed orchards. Idaho reported injury slight, but the disease common in neglected orchards. Washington stated that it is common in Western Washington and in central irrigated regions. For occurrence in California see below.

The following statement by D. F. Fisher, Office of Fruit Disease Investigations, United States Department of Agriculture, summarizes the importance of this disease in the interior apple growing districts of the Pacific northwest:

> "Powdery mildew is very prevalent and spreading in the interior irrigated districts of Washington, especially in the important producing sections at Wenatchee, Yakima, and Walla Walla. It is not serious in the Spokane district nor the Hood River Valley, Oregon where apple scab is prevalent and controlled by spraying.
>
> "Losses due to powdery mildew are difficult to measure on account of the character of the principal injury - a reduction in the vitality of the tree which results in crop reduction. Some badly affected orchards have failed to bear a crop for the last three years, and wherever infection is severe there is some loss for fruit buds fail to 'set' on infected twigs. Besides crop reduction, powdery mildew russets the growing apple and thereby excludes it from the extra fancy grade. In many localities fully 40% of the crop was so affected in 1919, and this loss can be assessed at about 25¢ to 30¢ a box."

P. S. Darlington, District Horticultural Inspector at Wenatchee, Washington, gives the following estimates of losses (Feb. 26, 1920):

> "The principal sources of loss affecting the fruit itself, so far as plant diseases and physiological troubles are concerned, are apple mildew and bitter pit or baldwin speck. There are, of course, some other losses of less consequence from such troubles as drought spot and stigmonose. Apple mildew is pretty widely scattered but is causing serious loss only in a few rather limited areas and I would scarcely know how to begin to estimate this loss. I believe loss from bitter pit is becoming less serious every year as the trees get older, but it still causes a considerable loss. I would say just as a rough guess that an estimate of from $150,000 to $200,000 loss from these two diseases in this district yearly would be a conservative estimate, and that would not take into consideration the loss caused by the mildew on future crops."

Charles L. Robinson, District Horticultural Inspector, at Yakima, Washington, gives the following figures for 1919 in the Yakima Valley:

> "I should judge that perhaps 10% of the fruit (apples) was lowered in grade on account of mildew markings. In addition to this there are many orchards in the Valley that are seriously injured as to fruit spur development and the general vigor of the trees. It is almost impossible to make an accurate estimate of the extent of that damage, but I should judge that it cut down the crop to the extent of at least several hundred cars."

W. S. Ballard, Office of Fruit Disease Investigations, United States Department of Agriculture, furnished the following statement concerning powdery mildew in California:

> "Apple powdery mildew is found in all the larger apple growing districts of California, including the Pajaro Valley, the Sebastopol district and Yucaipi district. It is impossible to measure the actual damage done by this disease, since in this state the infections occur practically entirely on the foliage and twigs, in contrast to the Northwest where the fruit also is often involved. There is, therefore, no direct crop loss due to powdery mildew attacking the fruit. In unsprayed orchards a large percentage of the leaves are usually infected and the severity of the infection may vary from a single small spot on the under side of the leaf to a complete covering of both the upper and lower surfaces. Even a small infection causes deformation and stunting of the growth of the leaf. To measure the damage done to the tree as a whole, and to its crop producing ability would involve first a quantitative determination of the loss in photosynthetic and other physiological activities occasioned by the powdery mildew, and this, for a number of reasons, would be very difficult to determine, so that the best that we can do is make a general comparison of the annual twig growth and of the abundance, size, and 'quality' of the foliage of badly diseased and comparatively healthy trees. Such a comparison is markedly in favor of the more healthy tree, even though our present methods of control are not sufficient to enable us

> to keep the tree entirely free from mildew. From a practical standpoint, with our present knowledge of methods and available fungicides, it is impossible to obtain complete control of apple powdery mildew on susceptible varieties in districts where climatic conditions favor its development. The result is that the grower spends such an amount of money on spraying, etc., as he considers justifiable, and thereby keeps his trees in as healthy condition as he feels is justified by the net returns."

In the light of these estimates it is interesting to contemplate the unique history of powdery mildew as affecting the apple industry of the United States. Widely and for years distributed over the older apple regions of the East, which until very recently have produced practically the entire commercial crop of the country, powdery mildew has seldom, if ever, been serious in bearing orchards.

Now with the enormous development of the apple industry in the irrigated valleys of the West, Washington in particular, where the sprays which are needed to control common foliage and fruit fungi of the humid regions are omitted, this disease has assumed an important role in bearing orchards. According to statistics published by the Bureau of Crop Estimates, Washington produced in 1918, 17.3% of the total commercial apple crop of the country. In 1919, a light year in general for the East, Washington produced 24.6% of the total commercial apple crop, or more than the combined commercial production of New York, Virginia, and Missouri for this year.

It will, therefore, be seen that the ravages of powdery mildew in an important state like Washington become at once a serious problem to the commercial apple industry.

The following statement regarding varietal susceptibility and control has kindly been furnished by D. F. Fisher (United States Department of Agriculture):

> "The most susceptible varieties are Jonathan, Esopus (Spitzenberg), Rome, and Gano (Black Ben Davis). The most resistant are Winter Pearmain, and Winesap.
>
> "In the irrigated districts the fungus depends upon the prevalence of dews for moisture for spore germination. First appearance of the disease is generally correlated with condition of full bloom, since infected buds that harbor the overwintering mycelium are delayed in opening until about this time.
>
> "Control depends upon efficient use of sulphur sprays at frequent intervals, supplemented by pruning out infected twigs. Efficient sulphur spraying is complicated by the susceptibility of the fruit to sulphur sunburn (see note on this subject), also to the difficulty of protecting the rapidly growing tips and under surfaces of the leaves, which are the most susceptible parts. Growers are also handicapped by lack of experience in this type of spraying, since they have never had to combat any other fungous disease and the technique of spraying differs from that required for insect control."

Heald stated that in the Yakima Valley a considerable amount of Sherwin Williams dry lime-sulphur has been used,

Fruit spot caused by Phoma pomi Passer.

Fruit spot was particularly serious in Arkansas in 1919, where the commercial apple crop is estimated to have suffered a loss of 15-25% from this disease. Elliott stated that it probably caused a loss of over $200,000 on Jonathans alone.

West Virginia (Giddings) reported 10% injury with 3% loss and mentioned that the disease was abundant and unusually general.

Pennsylvania, New Jersey, and Connecticut reported occasional occurrence with slight loss.

Illinois (Anderson) reported: "Phoma pomi rare, very slight damage. This is the first report of this disease in the state. Specimens of Grimes sent from Calhoun County were seriously infected. It is probable that it occurs in other parts of the state."

Presence of Phoma pomi on commercial shipments of apples in 1919 is reported as follows by the Bureau of Markets inspectors:

Table 30. Losses as shown by inspection of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	No. of cars with infection	Average percentage of infection	Range of percentage of infection	Remarks as to seriousness of infection
Arkansas	2	66	66	Severe infection.
Maine	1	4	3-5	Slightly spotted.
Maryland	1	40	40	Bad spotting.
New Hampshire	1	22	20-25	Estimate includes sooty blotch.
Pennsylvania	1	33	33	Bad spotting.
Virginia	2	33	17-50	Severe infection in one car.
West Virginia	2	100	100	Very bad spotting.
Total	10		Total number of cars inspected - 2973	

Jonathan, Grimes, and King David are the varieties which were most seriously affected in Arkansas and also considerable was reported on Ben Davis in that state. Jonathans were severely attacked in one locality in Pennsylvania.

Referring to control of this disease in Arkansas, John W. Roberts (United States Department of Agriculture) stated:

> "In well sprayed orchards the disease was almost perfectly controlled. Adequate control was not had by means of dusting. In our own plots, spraying gave almost perfect control, but the dust plots were badly affected. The check plots were 100% diseased."

Sooty blotch and fly speck caused by *Leptothyrium pomi* (Mont. & Fr.) Sacc. and *Phyllachora pomigera* (Schw.) Sacc.

The relative prevalence of sooty blotch in the apple producing regions of the United States, as reported by collaborators during the period of 1903 to 1919, suggests the following arrangement of the states in groups according to severity of the disease.

Table 31. Relative prevalence of sooty blotch on apple in the United States.

Groups	Relative prevalence.		Results of market inspection, 1919.	
	Average	1919	No. cars with sooty blotch	Average % fruits affected
I. (a) Pa., Md., Ohio, Va., Ind., W. Va. Ill., Ky. Mo., N. C.	Severe - Region of heaviest and most frequent losses	More: Pa., O., Ky. Average: W. Va., Va., Mo. Less: Ind., Ill.	17	36
(b) Mass., Ark. Conn., Nebr. R. I., N. J., Del.	Common, troublesome, sometimes severe, especially in Conn.	More: Conn. Average: N. J., Del.	3	24
(c) Tenn., Ga., S. C., Ala., Miss.	Mostly abundant no definite data.			
II. (a) Maine, Mich., Mont., N. H., Wis., Idaho Vt., Minn., Wash., N. Y.	Slight to rare.	More: Minn.	3	13
(b) Iowa, Okla., Kans., Texas	Slight to rare.	More: Kansas.	NOTE: 2,973 cars of apples were inspected in 1919, and of this number 23 were found affected with sooty blotch, as listed above.	
III. (a) Ore., Wyo. Calif., Nev., N. Mex., Colo.	None.			

Sooty blotch is widely distributed over the eastern half of the United States, or east of the 100th meridian, the Dakotas, Louisiana, and Florida being the only states which have not reported it, and, of course, apple production is inconsequential in North Dakota, Louisiana, and Florida, while South Dakota produced in 1919 only 302,000 bushels total and 3,000 barrels commercial crop. West of this line the disease is only reported from Montana, Idaho, and Washington, but no reports were received from any western states in 1919.

In all of the northern tier states from Maine to Washington, except North Dakota, sooty blotch is reported of small importance and generally slight to rare. This is evidenced by extracts from reports of these states as follows: Minnesota, the only state of this group to report on sooty blotch in 1919, stated "Disease reported from Hennepin and Wabasha Counties this year, infections moderately severe in both cases. Sooty blotch is not common in Minnesota, the first authentic report was from Blue Earth County in 1918". (Bisby) Montana reported sooty blotch to occur in that state in 1918, but gave no further data. Idaho (C. E. Temple) reported it "Prevalent, small injury" in the northern part of the state in 1913. Washington (W. A. Lawrence), 1907, reported fly speck from Jefferson, Pierce, and Whitman Counties. In 1908 Lawrence reported "Fly speck, Leptothyrium pomi, rare, only observed twice this year on a few apples collected late in the fall, Puyallup, Wash." Heald and George reported "Fly speck, Leptothyrium pomi," from Mason County in 1916.

The disease is apparently slight to rare also in Iowa, Kansas, Oklahoma, and Texas. In 1919 Kansas reported "Sooty blotch probably aided by wet season, very unusual for it to occur in Kansas." Oklahoma, 1919: "Few reports, not of much consequence."

Massachusetts, Connecticut, Rhode Island, New Jersey, and Delaware generally reported sooty blotch common and troublesome, often causing serious depreciation in market values of fruit, particularly from unsprayed orchards. For example, in 1906 and again in 1916 Connecticut reported concerning sooty blotch: "One of the worst apple diseases". Delaware averages about 1/2% of injury. In 1919 this group reported as follows: Connecticut - more than usual; New Jersey- common in neglected orchards; Delaware - as usual 1/2% to 1% of crop injured.

Farther west, sooty blotch is troublesome in Nebraska and Arkansas. In 1907 Nebraska reported "Leptothyrium pomi is present in the majority of orchards in eastern Nebraska". Since, it has frequently been reported as widespread, but estimates of losses are not given.

Reports indicate that heaviest and most frequent losses from sooty blotch occur in Pennsylvania, Ohio, Indiana, Illinois, Missouri, Virginia, West Virginia, Kentucky, and North Carolina. In 1910 Pennsylvania reported 10% injury, 1/2% loss; 1911 - 15% injury, 2% loss; 1914 - 10% injury, 5% loss; in 1917 - 8% depreciation in market value of fruit due to sooty blotch. In 1905 Ohio reported 20% injury, in 1909 - 50% injury in 14 counties with $100,000 loss. Indiana: 1908 - 25-30% injury in 4 counties; 1910 - 18-22% in several counties; 1911 - 5-8%; 1914-15 very common, 1916-17 less. Illinois: 1911, sooty blotch widespread, especiallly in southern part of state, large amount of injury in many orchards, 1912 less. Missouri: 1905 - 75-100% of crop injured in localities, about same until 1910 when Rolfs reported 50% to 80% of crop injured in several southern counties. The disease is abundant in Virginia, West Virginia, Kentucky, and North Carolina. It is also common and abundant in the other southern states east of the Mississippi, but reports of its relative prevalence are incomplete.

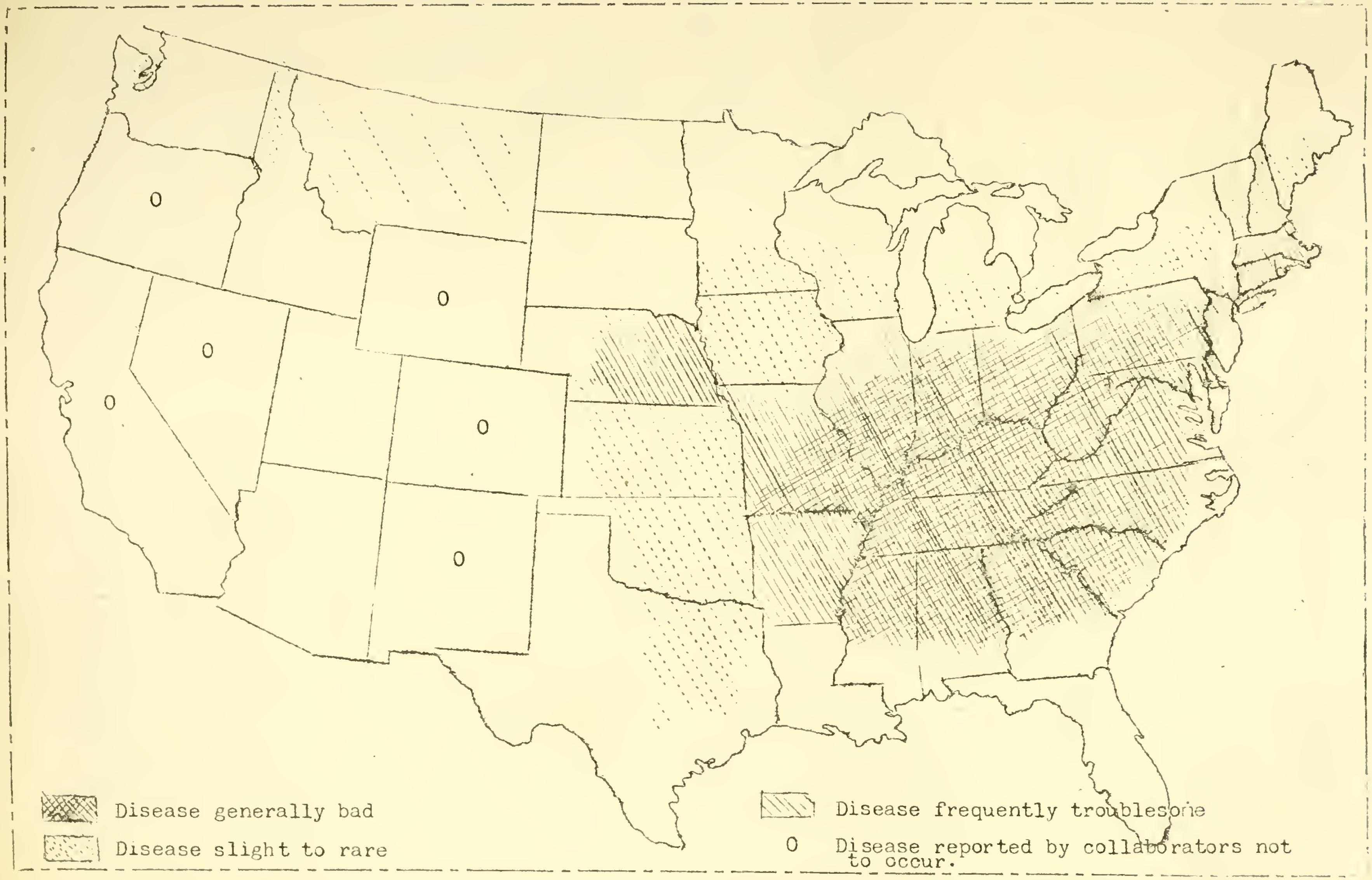

▨ Disease generally bad
▨ Disease slight to rare
▨ Disease frequently troublesome
0 Disease reported by collaborators not to occur.
0
0
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Fig. 27. Occurrence of sooty blotch in the United States, according to reports of collaborators.

In 1919 the above states reported sooty blotch as follows: Pennsylvania: More than in 1918, severe on York Imperial, 10-15% injury, 2-3% depreciation. West Virginia: Abundant 20% injury, slight loss, Bordeaux spray most effective. Ohio: More than usual, favored by late rains, midsummer copper sprays excellent. Kentucky: 100% injury where orchards were not sprayed. Indiana: No loss. Illinois: Rare. Missouri: Common, much injury.

Control in 1919

West Virginia:	Bordeaux sprays most effective.
Ohio:	Midsummer copper sprays excellent.

Blister canker caused by Nummularia discreta Tul.

This disease in 1919 caused, as usual, much damage in certain central states. Nebraska (Wilcox) stated: "Continues to be our most important disease." Kansas (Melchers) reported: "Reports at hand show that this disease was less common the past season than has been observed for the last five years. Apparently the abundant rain in the spring of 1919 gave the trees a more vigorous growth. It apparently made them less subject to attack. Fewer orchards were suffering from blister canker than usual."

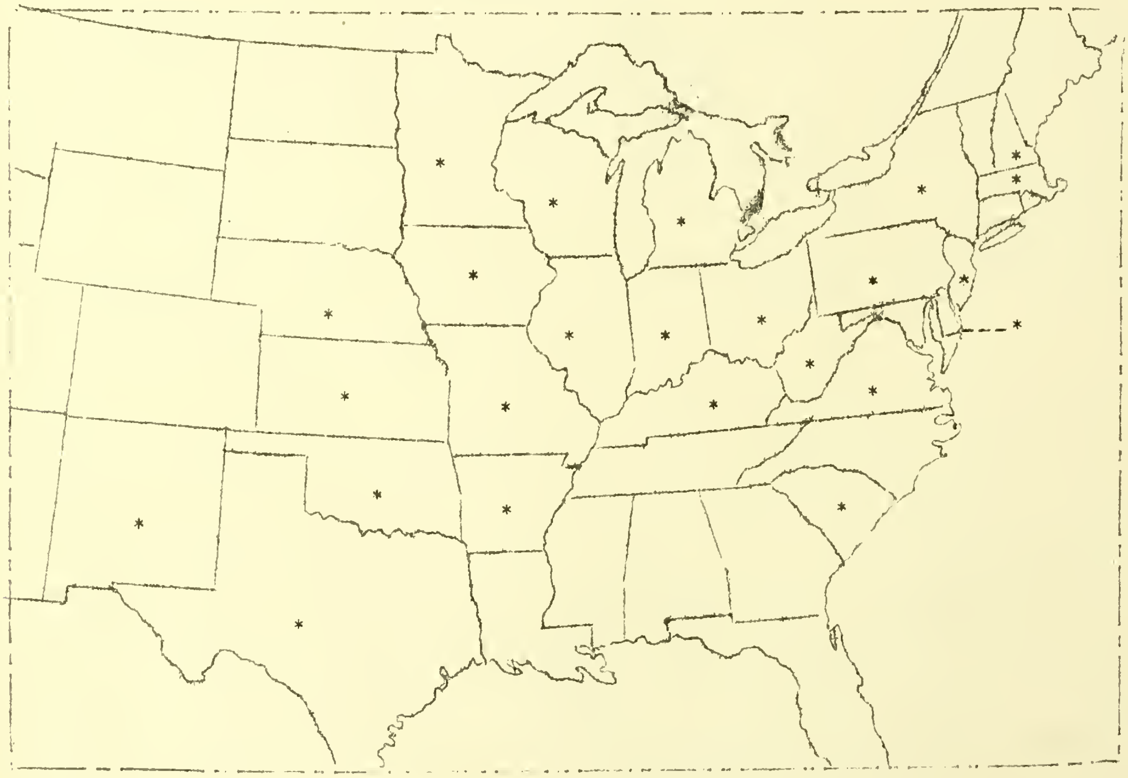

Fig. 28. States in which blister canker has been reported to occur.

Missouri (Maneval) reported the disease as general and severe, killing a good many trees each year. *Arkansas* (Elliott) estimated the injury to the crop at 5%, or $250,000. In *Oklahoma* it was reported as only present and not serious.

Blister canker also caused damage in the Ohio Valley. *Indiana* reported it very destructive locally in 1919. While prevalent in Illinois, injury was estimated at less than .1%. Injury was apparently slight in *Ohio*, *Pennsylvania*, *New York*, and the coastal states from Virginia northward. Bisby stated that the first authentic report of the occurrence of blister canker in Minnesota came from Winona County, April 13, 1919, when two trees were found affected. One other case was located later in the season, May 1, 1919, when a large canker was found on a healthy tree in a 10-acre orchard near St. Paul.

On the preceding map (Figure 28), the states from which collaborators have reported the occurrence of blister canker are marked with a "*".

Varietal susceptibility was reported as follows in 1919:

Most susceptible	*Commonly affected*
Ben Davis - Arkansas	Grimes - Illinois
" " - Illinois	Willow - Illinois
" " - Indiana	
" " - Pennsylvania	

Prof. Selby (Ohio) recommends control by removing and burning cankers before March 15. In Phytopathology 10 : 58, 1920, W. O. Gloyer published a summary of the occurrence and control of blister canker in New York.

Anthracnose caused by *Neofabraea malicorticis* (Cord.) Jackson.

A general summary of the history and extent of this disease has already been given (Plant Disease Bulletin, Suppl. 1:9, 1919).

In 1919 reports on the northwestern anthracnose were received only from Washington, although it is known to be present in Idaho, and severe in western Oregon. Greatest damage from the disease is reported to occur west of the Cascade Mountains in Washington and Oregon.

Heald and Dana (Washington) stated: "*Neofabraea malicorticis* is reported from widely separated points west of the Cascades." Arthur Frank furnished the following, dated July 8:

> "Report of survey of orchards April 10, 18, May 1 and 10, 1919. This was work done in the vicinity of Puyallup and up and down the valley and in nearby districts. The anthracnose (*Neofabraea malicorticis* (Cord.) Jack.) is generally prevalent and quite severe. More of the trouble is present this season than in the last three seasons. The trouble is spreading into many young orchards rapidly and is doing much damage. Most damage is done by the fungus girdling small limbs. In some cases the trunks of small trees are girdled. Many new cankers are present on one year old wood. Cankers were found giving off spores June 11, 1919, and cankers are found giving off spores at present time, July 7, 1919.

> "Bellingham, June 28, 1919: Visited orchards at Bellingham, Ferndale, Lynden and at points in the county between, Anthracnose is very severe in this county. Many of the older orchards have had the trouble for as long as 16 years or more. One orchard was seen which was reputed to have had the 'worst case in the Northwest'. The owner had sprayed last season and this spring there were no new cankers to be found. The trouble is more prevalent here than last season.
>
> "Vancouver, June 29, 1919: Some anthracnose present about Vancouver and nearby points but not so abundant as at other points."

Inspectors of the Bureau of Markets found 5% anthracnose in one car of apples from Oregon, and apples in two cars from Washington were found to contain 20-22% anthracnose associated with other decays.

Crown gall caused by _Bacterium tumefaciens_ Sm. & Towns.

Crown gall occurs in probably all apple growing regions of the United States. The fact that the bacterium has been prevalent in nurseries for many years, that it infects a wide range of hosts, and that it will survive under all ordinary conditions endured by the host, accounts for its very wide spread.

It is probably more difficult to estimate losses from crown gall than from any other apple disease. It would be possible to place a fairly accurate valuation upon annual losses in nurseries where cost of production is readily calculated and losses are definitely computed in a single season, but in commercial or home orchards the situation is exceedingly complex. Irregularity of occurrence would make it necessary to canvass each orchard in a given area. Many orchards are injured by this disease without the knowledge of the owner, the enemy remaining hidden beneath the soil, and in other orchards crown gall may be present but producing no apparent ill effects on the trees.

Trees infected when planted often die before they reach the bearing age from crown gall, or from secondary infections gaining entrance from the gall lesions. Frost injuries are known to pick crown gall trees frequently. Crown gall trees are generally stunted and less vigorous than uninfected trees, they will probably bear profitably at a later age and then may be expected to die several years before their normal producing period is completed, Losses to the grower include the factors involved in the cost-production of a bearing orchard and in decreased producing power.

It is, therefore, not surprising that only a few of the states where crown gall is known to occur report their losses for 1919. Most definite statements came this year from the following states: _Arkansas_ reported 10% crop injured; _Georgia_, common, trace to 50% injury, 10% loss; _Alabama_, general; _Oklahoma_ reported from three localities. Learn inspected one orchard of 20 acres where the root system of every tree examined was a mass of knots and fine roots. He suspects another orchard of 40 acres to be in the same condition; _Missouri_ reported the disease from one area; _Ohio_ reported chiefly nursery stock affected; _New York_, severe in one county; _New Mexico_ reported both aerial and crown forms, slight losses; _Idaho_ stated that the disease was not common. It was reported from two areas in _Washington_.

Brown rot caused by *Sclerotinia* sp.

For a summary of the occurrence and importance of this disease in the United States, see Plant Disease Bulletin, Supplement 1: 13, 1918. In 1919 it was reported as causing 0.5% to 1% injury to the crop in Delaware. Pennsylvania (Orton) reported it as causing 5-10% loss on Cox Orange at State College, and also on Baldwins. It was more prevalent than usual in the state, but caused very slight loss. Earliest report August 20th. In Indiana it was first reported June 4, but it was only slightly prevalent. South Carolina reported brown rot on storage apples only. Alabama reported it unusually general and severe. In Arkansas is caused a trace of injury, appearing first on Red Astrachan in June. Washington (Heald) stated: "Twig and blossom blight due to Sclerotinia sp. reported from a number of localities by Frank from Island and Whatcom Counties."

Table 32. Losses as shown by inspection of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	No. of cars with brown rot	Average percentage of brown rot	Range of percentage of brown rot	Remarks as to seriousness of decay.
Arkansas	5	6	3-12	Estimate includes some blue mold.
California	3	3	2-3	Slight decay.
Delaware	4	13	2-23	Two cars slight decay, two cars all stages of decay.
Idaho	1	9	8-10	Includes some blue mold.
Maine	1	3	2-4	Slight decay.
Maryland	1	27	25-30	
Michigan	1	13	10-15	
New Mexico	1	4	3-5	Slight decay.
New York	2	4	2-6	Slight decay.
Pennsylvania	1	5	5	Slight decay.
Texas	2	4	3-5	Slight decay.
Virginia	4	7	5-10	Mostly slight decay.
Washington	2	8	5-10	Mostly slight decay.
West Virginia	5	9	5-15	Decay mostly in spots.

Total 33   Number of cars inspected - 2973.

Blue mold rot caused by *Penicillium expansum* (Lk.) Emend. Thom.

Blue mold rot caused an immense amount of damage in 1919 to apples in transit and storage. The losses in common storage and in local markets are not easily estimated. Of carlot commercial shipments, the following data were collected by the inspectors of the Bureau of Markets. 2973 cars of apples were inspected at destination by the inspectors in 1919. Of this number, 706, having points of origin in 25 states and Canada (9 cars), were found to be infected with blue mold rot, *Penicillium expansum*, the rot affecting from 1 to

87% of the apples by cars, and averaging 10.2% of the total fruit in the 706 cars. Computed for the 2973 cars, 2.4% of all the apples inspected in 1919 by Bureau of Markets inspectors were affected with blue mold rot.

Bitter pit (non-parasitic)

> "The term bitter pit is used as snyonomous with 'Stippen' and Baldwin spot, the disease being characterized by brown spots and streaks in the region of the vascular, particularly the subepidermal tissue. The weather conditions in the eastern United States were not favorable to bitter pit the past season (1919) but there have been reports of some losses on Rhode Island Greening in sections such as New York state where the crop was light and the fruit, therefore, somewhat forced in its growth." (Charles Brooks, Office of Fruit Disease Investigations, United States Department of Agriculture).

Arkansas (Elliott) reported for 1919: "Probably the worst outbreak of this disease ever known here. It appeared early in August on Grimes and Jonathan. Some Jonathan crops entirely reduced to culls. Other orchards not injured in the least". Virginia (Fromme): "Quite severe on King David from Rockingham County." Pennsylvania (Orton): "Baldwins and Spys reported as being generally affected." New Jersey: Very common. Connecticut: Much less than usual, one report only. Ohio (Selby): "Relative prevalence normal, small injury, weather conditions favorable to disease, and early maturing of the fruit." Michigan (Coons): "Complaint that there is an abundance of bitter pit in Oakland County this year." Idaho (Hungerford): "Reported to be common in Twin Falls County, no survey made." New Mexico (Leonian): "Local, Stayman Winesap most susceptible." Washington (Heald & Dana): "Reported from both eastern and western Washington, common in central irrigated regions also." (See also P. S. Darlington's estimate of losses from powdery mildew and bitter pit at Wenatchee, under "Powdery Mildew", page 118).

Of the 2,973 cars of apples inspected by the Bureau of Markets inspectors in 1919, 42 were found to be affected by bitter pit as follows: 5 cars from eastern, 5 from central, and 31 from western states.

Table 33. Losses from bitter pit as shown by inspection of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	No. of cars with bitter pit	Average percentage of fruits affected
Delaware	1	5
Virginia	4	4
West Virginia	1	10
Illinois	1	15
Arkansas	4	10
Idaho	1	12
Washington	10	15
Oregon	1	9
California	19	11
Total....................	42	Number of cars inspected - 2,973.

Summary of Varieties Reported Affected in 1919.

Arkansas: Jonathan, Grimes, Ben Davis, Winesap, Delicious.
Virginia: King David.
Pennsylvania: Baldwin, Northern Spy.
New Mexico: Stayman Winesap (most susceptible).

Rosette.

Rosette of the apple is generally rare throughout the eastern half of the United States. In fact the dense tuft of leaves (rosette) terminating a branch or shoot otherwise practically bare, which characterizes this disorder, is so seldom encountered as to be almost a curiosity.

In 1901 Paddock described rosette and called attention to its importance in certain apple regions of Colorado. From 1910 to 1914 it began to be noted widely in Idaho, Oregon, and Washington.

In 1919, in addition to its usual occurrence, rosette was reported for the first time from three or four localities in Kansas by Melchers, attended by no serious injury. In Idaho for this year it was reported: "One of our most common apple diseases."

Few estimates of losses from this disease have been received. Idaho placed injury in 1919 at 5%, and the estimated loss in the state at 3% of the total crop. Slight varietal resistance is claimed.

In a 1904 Colorado report, Paddock stated concerning rosette: "This is a disease which results from an uncongenial soil condition, a poor water supply and winter injury."

Hungerford (Idaho, 1919) remarked: "Clearly associated with soil conditions. Hard pan, slick spots, shallow soil, high water table, all have been associated with the trouble (rosette)."

The following statement concerning rosette in the interior irrigated districts of the Pacific Northwest is furnished by D. F. Fisher and Charles Brooks, Office of Fruit Disease Investigations, United States Department of Agriculture:

> "Rosette is associated with an unbalanced condition of moisture and nutrition. It is most frequently found on very compact soils, on shallow soils underlaid by 'hardpan', or on soils where the humus content has been exhausted by continuous clean cultivation with consequent tendency towards 'baking' or 'puddling' of the soil following irrigation and the formation of a 'cultivation sole' a few inches below the surface which effectively prevents adequate irrigation of the tree.
>
> "Inadequate irrigation of the tree in itself apparently is not the direct cause of rosette, for this trouble in no wise resembles typical drought effects. But an inadequate moisture supply necessarily unbalances the food supply, either permitting excessive concentration of certain injurious salts or depriving the tree of certain necessary elements.
>
> "But whatever the factors involved, it has been demonstrated that with the more general adpotion of alfalfa as a permanent orchard cover crop in the irrigated districts of the Northwest, the

spread of rosette has been arrested. Improvement in rosette conditions is not particularly noticeable until about the 3rd year after alfalfa is established, but after this time it is rapid and by the 5th year the trouble usually disappears entirely. Blasting the soil gives only temporary relief, since it does not remove the causes contributing to the original soil condition. Applications of fertilizers are not effective unless the physical condition of the soil is corrected. Shallow rooted cover crops, such as red clover and vetch are likewise not effective. Pruning out rosetted branches results in accentuating the trouble and it is best to leave affected trees unpruned."

Jonathan spot (probably non-parasitic).

The following states reported Jonathan spot in 1919: Delaware, in storage only; Ohio, relative prevalence less; Michigan, "Occurring in abundance on Jonathan on trees near Farmington, Mich." (Coons, Nov. 1, 1919); Idaho, always common on Jonathan apples picked late and stored; Washington, common in central and eastern districts.

Water-core (non-parasitic).

Water-core is known to occur widely over the apple-producing regions of the country. While reports are not sufficiently complete for a general survey of its behavior, some states have given a fair idea of local occurrence.

Selby reported from Ohio: 1915 - Water-core has developed to an unusual extent, serious in Delicious and King David at Wooster. Results of all investigations show that early picking can be relied upon to reduce or prevent water-core. 1916 - "Prompt picking and low nitrogen". 1917 - "Follows too late picking of varieties." 1919 - More prevalent than usual in that fruit matured early. Fruit should be picked promptly.

Pennsylvania reported: 1915 - Slight loss, 2% injury. 1917 - 3% injury in three counties. 1918 - York Imperial affected in certain orchards, watery part confined chiefly to flesh, "glassiness". 1919 - Some at State College on Wolf River.

New Jersey: 1918 - Occasional. 1919 - Occasional.

New York: 1918 - Common on Transparent, Bough (Sweet Bough), Pound Sweet.

California: 1917 - Fairly serious.

Charles Brooks and D. F. Fisher, (Office of Fruit Disease Investigations, United States Department of Agriculture) furnish the following data for the Pacific Northwest:

> "Most susceptible varieties: Tompkins King, Winesap, Delicious, Newtown, and certain summer apples - Red Astrachan and Waxen in particular. Not as serious in the Pacific Northwest in 1919 as in 1918. Influence of irrigation and fertilization not established."

Drouth spot (non-parasitic).

"The term drouth spot is used to refer to masses of dry corky tissue in the flesh of the apple. The spots are usually much larger and more deeply seated than bitter pit spots. The disease was far less prevalent than in 1918 but caused some losses on York Imperial in Virginia, West Virginia, Maryland, and Pennsylvania." Charles Brooks (United States Department of Agriculture). Idaho (Hungerford) reported drought spot and cork in 1919 as follows: "This trouble has been reported from various sections of the state where apples have been grown without irrigation and with insufficient moisture."

Storage scald (non-parasitic)

> "Several varieties of apples were held rather beyond their usual storage season (1919-1920) but the cold weather that prevailed made it possible to market them in most cases without heavy losses from scald. Grimes showed scald on the markets by the middle of December, and York Imperial and Black Twig by the middle of January. Apples in baskets, boxes, or ventilated barrels scalded less than those in the usual tight barrels. Apples in unoiled wrappers scalded as badly as unwrapped apples but those in oiled wrappers remained free from scald." Charles Brooks, United States Department of Agriculture.

In the following table it will be seen that of the 2,973 cars of apples inspected by the Bureau of Markets inspectors in 1919, 48 cars were affected with scald, 11 from eastern and 37 from western states.

Table 34. Losses from scald caused by physiological conditions as shown by inspection of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	No. of cars with scald	Average percentage of scald	Range of percentage of scald	Remarks as to seriousness of scald
New York	1	9	7-12	
Delaware	1	6	6	Slight scald.
Pennsylvania	1	8	5-10	Deep scald.
Virginia	6	20	5-45	Some bad scald.
West Virginia	1	40	40	Affecting one-third to two-thirds of surface of affected apples.
Michigan	1	100	100	All degrees of severity.
Washington	35	15	2 cars 50-100	Slight scald on large percentage of fruit.
			33 cars 2-27	All degrees of severity.
Oregon	1	7	7	
California	1	20	20	Slight scald.

Total..... 48 Total number of cars inspected - 2973.

Sun scald (non-parasitic)

New Jersey (Cook): Sunburn very severe and the cause of heavy losses due to exceptionally hot weather on July 4 and 5. Ohio (Selby): Relative prevalence about same, resulting from excessive exposure of upright stems, reported May 5. Virginia: Some injury in early August during exceedingly hot weather.

Winter injury caused by low winter temperatures.

Connecticut: Effects of severe winter of 1917-18 still evident in injured and dying trees. Pennsylvania: Crotch injury on York Imperial in Franklin County and brown pith in twigs of Northern Spy in Wayne County. Both may have been caused by winter of 1917-18. Ohio: Relative prevalence less, cases reported largely carried over from 1918. Idaho: Rather serious winter injury in Kootenai County. Washington: Reported from several localities in western, central, and eastern districts.

Spring frost injury.

Frost injury in 1919 was reported by several states. Connecticut: Late frosts in May hurt blossoms considerably in certain localities, so that crop was light in places, some injury to leaves. Pennsylvania: Foliage severely injured at Phoenixville, Pa., 20% of foliage showed marked blisters (May 5). West Virginia: Foliage of many varieties injured by late frosts. The cold weather which prevailed at blossoming time resulted in much injury to them, apparently not due to frost, but to cold windy weather. Fruit set was comparatively light as a result. Ohio: Frost banding reported from Lawrence County, June 25, as bad on Gano variety. Indiana: Frost on April 25, 26, 27 was very prevalent and state-wide. Injury was very severe. In the southern part of the state peculiar scarred areas about the calyx end, and the familiar frost band was common while in the northern part of the state in many cases the frost resulted in the total destruction of the blossom. Illinois: (Anderson) "There has been an unusual amount of leaf yellowing and dropping this season. There was a frost with temperatures of 24-30° throughout the state April 26-27. The apples were in full bloom in central Illinois at this time. This was followed by good growing weather until the week of May 19-24, when there were several days of cold, rainy weather. This was followed by very warm, dry weather. The older leaves suffered most. The condition was noticed on other fruits also." Montana: Slight russeting in certain localities. Idaho: Frost banding reported from the Panhandle. Washington: Severe spring frosts caused more than usual injury, much young fruit killed by the late frosts, especially in eastern Washington, frost blistering and curling of leaves very common throughout the state.

Fall frost and freezing injury.

> "Heavy losses from freezing were sustained on northwestern apples in transit. The losses were brought about by inability to get suitable cars, abnormally cold weather, and unusual delay in shipments." (Charles Brooks, United States Department of Agriculture).

Oregon reported "Hood River Valley apple crop damaged 4% to 5% by severe frost. Some damage to fruit on trees and in boxes still in orchard." (Bureau of Crop Estimates, Weekly Crop Notes, Oct. 26 to Nov. 1, 1919.)

Hail injury (non-parasitic)

Michigan (Coons): Hail injury common in Oakland County.

Spray injury.

Sulphur sun scald of apples in the interior regions of the Pacific Northwest, east of the Cascade Mountains, is reported as follows by D. F. Fisher and Charles Brooks (United States Department of Agriculture):

> "Occurs following application of sulphur in any form during the period of intense sunlight when shade temperature exceeds 90° F. Only apples exposed to the direct rays of the sun during the hottest parts of the day are usually affected. Foliage injury accompanying the fruit burning is ordinarily inconsequential. Has been known to occur fully 3 weeks after sulphur was applied, - when burning temperature was thus delayed. Mildew control after the early spring season is greatly complicated by the practical certainty of sulphur sunscald resulting from application of the most effective spray materials."

Idaho (Hungerford) reported slight loss by burning from lime sulphur from northern and southern counties.

New Jersey (Cook) stated: "Spray injury very common where concentrated lime-sulphur 1 to 40 was used as a summer spray".

John W. Roberts (United States Department of Agriculture) stated concerning spray injury in Virginia, West Virginia, Maryland, and Delaware in 1919: "Spray injury from lime-sulphur and from Bordeaux mixture was more than usually severe".

Connecticut reported, "Bordeaux, lime-sulphur, copper lime sulphur, calcium arsenate (liquid) all caused trouble, although calcium arsenate in the dry form apparently caused less injury than when wet. Bordeaux injury consisted mainly in russeting of the fruit."

Ohio (Selby) reported, "No cases of arsenical injury clearly evident. Clear evidence of danger from high pressure with spray gun". The cause is given as "mechanical - large disc and particles in sprays". Instances of 40% injury to the crop were cited, resulting from leaf drop. In a letter from D. C. Babcock, June 19, 1919, (Ohio) it was stated: "I have noticed some damage from the use of the spray gun on apple foliage and the leaves on some of the trees were burned to an extent of probably 75%. The conclusion was that the operator had manipulated the gun too close to the foliage."

Pennsylvania (Orton) reported: "Sodium arsenate defoliated trees sprayed by the State Department at Harrisburg (Wyoming County)".

Virginia (Fromme) reported: "A good deal of complaint of spray burn, especially on foliage from early summer applications."

SUMMARY - Sprays and dusts reported as causing injuries in 1919.

Material	Locality	Injury
Bordeaux Mixture	Md., Va., W.Va., Del.	Injury more severe than usual.
	Conn.	Injury - mainly russeting of fruit.
Sulphur	Pacific Northwest	Sulphur in any form liable to cause trouble.
Lime-Sulphur	Md., Va., W.Va., Del.	Injury more severe than usual.
	N. J.	Injury very common, where concentrated lime-sulphur diluted 1-40 was used as summer spray.
	Idaho	Slight.
Calcium Arsenate	Conn.	Less injury when dry form was used.
Sodium Arsenate	Pa.	Caused defoliation.
Spray injury from using spray gun with too high pressure	Ohio	

Miscellaneous fruit rots and spots

Fruit rot caused by Alternaria sp.

Colorado: Winesap especially susceptible. Reported on several cars shipped out of state.

New Jersey: Blossom end rot (Alternaria sp.) common but not serious.

Washington: Alternaria sp. caused rot of fruit at Pullman, Febr. 10, 1919, but less serious than the Penicillium rot.

NOTE: Mel. T. Cook (New Jersey) reported Alternaria sp. causing Jonathan spot, and the disease very abundant.

Pink rot caused by Cephalothecium roseum (Fries) Cda.

New Jersey: Common, but of little importance.

Ohio: Occurred in October. Associated with black rot, aided by much late season rain.

Washington: Found Jan. 13, 1919 in Mason County.

Rot caused by Phytophthora cactorum (Lib. and Cohn) Schröt.

Connecticut: (Clinton) Apparently common; first report last year; small amount of injury on falling rotting apples under tree.

Late red spotting, cause doubtful (Barss).

Oregon: Apples having yellow skins, especially Yellow Newtown, are lately being reported as affected by small red spots, each centering in a lenticel and resembling very closely the appearance of San Jose scale spots. The late picked fruit (and picking continued unusually late this year) in a good many orchards showed this effect. Rainy weather had occurred and rather low temperatures before such fruit was off. Copper sprays seemed to induce earlier and more abundant appearance of this condition.

Storage rots caused by various fungi.

"The unusual amount of small scab spots on the stored apples has resulted in larger losses than usual from storage rots." Charles Brooks, United States Department of Agriculture.

Miscellaneous leaf spots.

Cercospora mali - Texas (Taubenhaus) reported from Bexar and Guadalupe Counties, unimportant.

A silver leaf disease reported by Heald and Dana from Okanogan distirct, Washington, Mar. 26, 1919.

Miscellaneous bark cankers.

Brown bark spot (non-parasitic) reported by Heald and Dana from Stevens County, Washington.

Canker caused by Septobasidium pedicillatum (Schw.) Pat.
(Thelephora pedicillata Schw.)

This disease was reported by a county agent at Covington County, Miss., as abundant on limbs in an entire orchard.

A scurfy bark canker was reported by Leonian (N. Mex.) on some 700 Delicious trees. The trees of this variety were badly affected with the disease, while other trees in the same orchard were not at all affected.

Cytospora canker thought to be caused by Cytospora sp. and another undetermined fungus was reported from New Mexico by L. H. Leonian as follows:

> "Widespread and very active in the final destruction of trees. Some orchards show as high as fifty percent infection but these organisms are only weak parasites and follow woody apple aphis, giant fruit tree borer, and presence of large amount of nitrates in the soil as has been demonstrated by digging out a large number of cankered trees, the roots of which were in all cases infested with either aphis or borer, or both. Analysis of soil showed nitrates in such large amounts as to be injurious to plants. Inoculation experiments with Cytospora showed that it was a weak parasite and unable to attack healthy trees."

Myxosporium corticolum (Edgerton) was reported by Clinton as occasionally occurring in Connecticut, probably following winter injury.

A bark canker showing fruiting bodies of Rhabdospora rhoina (Peck) was reported by Bisby (Minnesota) as follows:

> "Bark canker, one report from Hennepin County. The canker was 6-10 inches broad, bark gray - similar to gray bark of raspberry. The pycindia are sub-epidermal. First report for Minnesota, June 13, 1919."

A bark canker showing Radulum aterrimum (Fries) was reported by Bisby from Ramsey County, Minnesota. The organism seemed to be causing a distinct canker. This is the first report for the state.

Schizophyllum commune (Fries) was reported as common in Ohio, Missouri, and Minnesota.

"Measles" - Leonian (New Mexico) reported concerning this disease in 1919:

> "Very common and destructive. Affected trees remain stunted for years and eventually die. The bark shows purplish small pustules in large patches. Spots in which affected trees grow enlarge from year to year forming circular areas where only a few plants can grow and the trees become invariably measled. Soil from these spots has been analyzed showing the presence of nitrates and carbonates in such large amounts as to be positively injurious to the growing things."

Virginia reported "Measles" from Patrick County, March 10, 1919, and stated it was apparently the same disease as that described by Hewitt, Bulletin 112 of the Arkansas Experiment Station.

ROOT ROTS

Armillaria root-rot was reported common and causing a trace of loss in Arkansas. New York reported root-rot, probably Armillaria sp. causing local damage in Wayne and Monroe Counties.

Clitocybe root-rot was reported along with Armillaria (above) from Arkansas, as causing a trace of loss.

Ozonium omnivorum Shear was reported prevalent in Texas, causing 5% loss.

Xylaria root-rot was reported as follows:

- Arkansas: General, trace of injury in Benton and Washington Counties.
- Illinois: Black root-rot, Xylaria sp., scattered. very slight injury, disease found only in three or four orchards in the extreme southern parts of state.
- Indiana: 0.5% loss, fairly common in southern Indiana.
- Pennsylvania: Found, with fruiting bodies, August 20 in Franklin County: "First record in Pennsylvania as far as we know" (Orton). Loss slight, two trees out of 54 found in one orchard.

Miscellaneous root rots, unidentified, were reported as follows in 1919:

Missouri: Gano variety affected with undetermined root-rot in Marion County.
Ohio: Undetermined root-rot in three counties.
West Virginia: Slight loss from root-rot in Braxton and Monroe Counties.

"Collar rot" was reported as follows:

Ohio: Freezing and subsequent infection.
Washington: Very prevalent in central and eastern Washington.

PEAR

Blight caused by *Bacillus amylovorus* (Burr.) Trevisan.

This disease was reported in 1919 from practically all regions where the pear is grown. Greatest losses occurred in southern Indiana, and in certain states in the southeastern section of the country, namely, Kentucky, Tennessee, North Carolina, South Carolina, Georgia, Alabama, Mississippi, and Louisiana. The total production of pears in this area in 1919 was about 1,321,000 bushels, or not far from 10% of the total United States crop. Losses from pear blight were estimated at from 10 to 50% by states. Indiana reported 75% injury to the crop.

Heavy losses were also reported from Colorado and New Mexico. Leach (Colorado) reported the disease abundant, severe, and causing the usual amount of damage. Leonian (New Mexico) stated: "Sudden outbreak all over the state. Average loss about 10 to 15%. Most serious in the history of the pear industry in New Mexico. Formerly considered unimportant."

Moderate losses, not generally exceeding 1%, were reported from Vermont, Massachusetts, Connecticut, Rhode Island, New Jersey, Pennsylvania, Delaware, Virginia, Arkansas, and Texas.

In the West, Washington reported the occurrence of pear blight in a few localities. No reports, however, were received from the important pear state of California, where in 1919 the crop was estimated at 4,096,000 bushels, only a little short of the combined production of the four next largest pear producing states of this year, Washington, New York, Oregon, and New Jersey.

Oregon reported the disease severe in Josephine County. In the Rogue River Valley, where the pear industry was threatened with extermination by this disease, a course of vigilant eradication has proven highly successful. This work was begun by M. B. Waite in 1906 and carried on for several years by P. J. O'Gara. In late years Mr. C. C. Cate, County Pathologist at Medford, has conducted the orchard inspection and eradication. The work has been regarded as a community problem. Hold-over cases in top, body, collar, and root have been systematically looked for and the infected parts destroyed.

An important step in the success of this campaign against pear blight in Oregon has been the detection and eradication of collar blight, working along lines similar to those developed by M. B. Waite, in the California orchards in 1905-06 and '07, (see below). Collar cases, though perhaps entirely beneath the soil, have been located and eradicated. It has been observed that this form of the disease, even though not visible above ground, is a source of blossom infection and may initiate an outbreak of blossom blight. Excavating about the collars of all trees in an orchard, frequently reveals several such hold-over cases. In instances where blossom blight has been epiphytotic, although eradication in tops and bodies had been practiced by experienced men, the source of first blossom infection has been traced to these buried holdovers, and their eradication has had an important influence in controlling the disease. The experiment of producing blossom blight with the pear blight organism isolated from collar blight cases was repeated by the writer (Hutchins) from the collars and from the tops of pear trees, Idaho variety, at Wenatchee, Washington, in November, 1919. The organisms were kept in pure culture and inoculated into Kieffer pear blossoms at the Experimental Farm of the United States Department of Agriculture, Arlington, Virginia, in April, 1920 - producing typical blossom blight in both cases.

M. B. Waite, (United States Department of Agriculture) furnishes the following statement concerning the occurrence of the collar blight form of pear blight:

> "This form of pear blight has proved one of the meanest forms of this disease in eradication and control work, partly because it is rather difficult to find on account of the thick and rough, scaly bark at that point, and partly because a small area of the blight does the maximum amount of damage to the tree. Its attacks are extremely erratic and appear to bear no very direct relation to the amount of the various forms of top-blight on the trees. It was found abundantly by me at Montrose, Delta, Peonia, and Grand Junction, Colorado, mostly on Bartlett pears, in 1903 and 1904. In the California campaign on the eradication of pear blight, it was found in a great many orchards of that state, both in the San Joaquin and the Sacramento Valleys and in adjacent smaller valleys in 1905, 1906, and 1907. Some orchards with an abundance of top-blight had little trouble at the collars of the trees, while other orchards having only a moderate amount of top-blight were badly attacked by this aggravated form. A special method had to be adopted for locating it. This was as follows: A three-fourths inch gouge with the bevel on the outside was carried by the inspector, and a little concave chip one-half inch in diameter, was made through the rough bark, exposing the greenish-white live inner bark. A sponge with a sublimate solution was carried and each cut was saturated with this solution and the gouge wiped before making the next. The Bartlett pears were usually gouged on each side and if any considerable quantity of collar blight was found, a second set of gouge marks was made on the opposite sides between the first cuts. When the gouge-mark showed the blight, the case was followed up and eradicated. Many beautiful and apparently sound trees with no blight in the tops (there being blight nearby in the orchard) were found affected at the collar. Collar blight was found in the outbreak at Medford, Oregon, in the autumn of 1906, and in subsequent years. In 1907 and for some six years thereafter, P. J. O'Gara conducted a strenuous fight against it along with his other efforts to eradicate blight in that region. At Walla Walla, Washington, in the extensive Blalock Orchards, a number of striking cases were found with still

more abundant body blight and various forms of top blight. In 1906, at Payette, Idaho, a number of cases of collar blight on Bartlett, and perhaps other pears, were located.

"In the bad outbreak of pear blight on the Bartlett pears in western New York from 1903 to 1907, a great many cases of collar blight were found, especially in Niagara, Monroe, and Orleans Counties. These occurred in the presence of still greater quantities of body blight and tip blight."

For occurrence of this disease on other hosts see apple (page 115), pear (page 138), quince (page 143), plum (page 159), and loquat (page 178).

Scab caused by Venturia pyrina Adehr.

This disease was reported in 1919 by only a partial list of the states in which it occurs. Vermont reported severe loss; Pennsylvania - 2% loss; New Jersey - common in neglected orchards; Connecticut - some; Delaware - about 1% loss; Ohio - less, crop short; Indiana - rare; Washington - severe in western, none in eastern parts of state.

Black rot caused by Physalospora cydoniae Arnaud.

Black rot was reported from Stark County, Ohio (Selby) as "rather less, earliest report September 7, Bordeaux sprays in July good", and from Arkansas where it was common. Inspectors of the Bureau of Markets reported it as follows:

Table 35. Losses from black rot as shown by inspection of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	No. of cars with decay	Average percentage of decay	Range of percentage of decay	Remarks as to seriousness of decay.
Arkansas	2	24	20-28	
Georgia	3	23	5-45	
Illinois	4	22	10-43	Considerable complete decay.
Indiana	1	40	40	(Rhizopus).
Missouri	3	10	2-25	Estimate includes some blue mold.
Oklahoma	2	15	10-20	Estimate includes some brown rot.
Texas	3	19	1-37	Decay heaviest in top of loads.
Wisconsin	1	9	9-10	One-fourth of decay complete.
Unknown	1	43	40-45	Decay mostly in spots, occasional pear completely decayed.

Total.....20 Total number of cars inspected ...... 270.

Blue mold rot, caused by Penicillium expansum (Lk.) emend. Thom

Rotting of fruit in transit, caused by the P. expansum, was reported as follows by Bureau of Markets inspectors:

Table 36. Losses from blue mold rot as shown by inspection of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	No. of cars with decay	Average percentage of decay	Range of percentage of decay	Remarks as to seriousness of decay.
California	3	3	2-5	Most of decay occurred in top of loads.
Colorado	3	15	7-20	Estimate includes some brown rot.
Illinois	2	6	3-10	Mostly slight decay.
Michigan	1	--	0-75	Most baskets showed no decay.
Missouri	1	27	25-30	Estimate includes black rot.
New Mexico	2	2	2	Slight decay.
New York	1	5	4-5	
Washington	5	5	1-13	All stages of decay, considerable complete decay.
Unknown	1	21	20-22	Mostly in spots.
Total.....19			Total number of cars inspected ..... 270.	

Soft rot caused by Rhizopus sp.

Losses caused by soft rot of fruit in transit were reported as follows in 1919 by inspectors of the Bureau of Markets.

Table 37. Losses from soft rot as shown by inspection of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	No. of cars with decay	Average percentage of decay	Range of percentage of decay	Remarks as to seriousness of decay.
California	10	8	2-15	Mostly slight decay.
Illinois	1	80	75-85	From 1 to 6 spots on affected stock.
Indiana	1	57	55-60	
New Jersey	1	43	40-45	Two-thirds in spots, balance complete.
New York	6	10	5-23	Considerable complete decay in one car.
Washington	4	6	2-13	Mostly in advanced stages.
Wisconsin	1	5	5	
Total......24			Total number of cars inspected 270	

Brown rot caused by Sclerotinia sp.

South Carolina in 1919 reported brown rot common where pears where held in storage. Losses from this disease on fruit in transit was reported as follows by inspectors of the Bureau of Markets:

Table 38. Losses from brown rot as shown by inspection of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	No. of cars with decay	Average percentage of decay	Range of percentage of decay	Remarks as to seriousness of decay.
Alabama	1	42	42	Average for the load.
Colorado	1	20	20	Estimate includes blue mold
Illinois	1	17	15-20	Spots ranging in size from a dime to one-third of surface.
New York	1/2	11	10-12	Spots one-eighth to one-half inch in diameter.
Texas	1	53	50-55	

Total......4 1/2 Total number of cars inspected 270

Fabraea maculata (Lev.) Atk.

New Jersey reported this disease in 1919: Very abundant and very destructive in some orchards, especially in the southern part of the state. Delaware reported it very prevalent throughout vicinities of Woodside, Wyoming, and Dover, where 50% loss occurred in some orchards.

Crown gall caused by Bacterium tumefaciens Sm. & Towns.

Crown gall was reported as follows in 1919: Arkansas: general; Arizona: a serious menace to all kinds of fruit trees including pear; Washington: present in Kittitas County.

Other diseases.

Phytopthora rot, caused by Phytophthora cactorum (Lib. & Cohn) Schröt., was reported as follows by Clinton, (Connecticut): "New to the state, but apparently common this year. Percent of injury small, found chiefly on fallen fruit rotting under trees. Only mycelium present in fruit, but in cultures oospores were produced abundantly".

Sooty blotch, caused by Leptothyrium pomi (Mont. & Fr.) Sacc., was reported causing 1% or less injury in Delaware.

Brown blotch, cause uncertain, was reported common by Cook, in New Jersey.

Powdery mildew, caused by Podosphaera leucotricha (E. & E.) Salm., was reported from Pierce County, Washington (Heald & Dana). First appearance June 30, 1919.

Leaf spot, caused by Phyllosticta pyrina Sacc. One specimen was received by Maneval, from Cole County, Missouri.

Leaf spot, caused by Mycosphaerella sentina (Fr.) Schrot. (Septoria pyricola) was reported April 16, 1919, from two localities in southeastern Alabama.

Armillaria mellea Vahl. was reported by Heald as causing considerable trouble in an orchard near Olympia, Washington.

Ozonium omnivorum Shear was reported by Taubenhaus from five counties in eastern Texas.

Chlorosis (non-parasitic) was reported in 1919 from New Mexico by Leonian as "generally present. In extreme cases leaves turn white, then brown, and die. Trees may be entirely defoliated". In serious cases trees are dwarfed. First report - May.

Drought injury reported by Heald and Dana from southeastern Washington.

Failure of blossoms to set was reported in 1919 from Delaware (Manns), as resulting in a very light crop. This behavior was attributed to an unfavorable season.

Winter injury was reported from western, southern, and eastern Washington (Heald & Dana). An orchard of dwarf pears near Olympia was mentioned as being severely injured.

QUINCE

Fire blight caused by Bacillus amylovorus (Burr.) Trevisan.

Fire blight on quince in 1919 resulted in about normal losses in New Hampshire, Connecticut, and New Jersey. Delaware reported the disease less severe. Pennsylvania reported relative prevalence as usual, considerable injury with slight loss, earliest report June 5 in Center County, early maturing of wood checked the disease. In Ohio losses by blight were much less than usual, which was attributed to killing of the blossoms by late frost. South Carolina and Texas reported a trace of injury.

Leaf blight caused by Fabraea maculata (Lev.) Atk.

This disease in 1919 was reported from New Jersey (abundant and very severe), and from Illinois (very abundant, no crop on account of frost, leaves lost by August 1. First appearance May 20 at Lilly, Illinois.)

Other diseases.

Crown gall caused by Bacterium tumefaciens Smith & Towns. reported from King County, Washington.

Black rot caused by Physalospora cydoniae Arnaud was reported in 1919 from New Jersey (very abundant and very severe), Delaware (common, 5% injury), and Ohio (more severe than usual).

Brown rot caused by Sclerotinia sp. was reported from Pierce County, Washington.

Powdery mildew caused by Podosphaera leucotricha (E. & E.) Salm. was reported by Heald and Dana from Pierce and Jefferson Counties, Washington.

Rusts were reported as follows in 1919: Gymnosporangium clavipes C. & P.- very severe locally in Montgomery County, Virginia. The earliest report was from Christiansburg, July 10.

Gymnosporangium clavariaeforme (Jacq.) DeC. was reported from Belknap and Rockingham Counties, New Hampshire, June 23.

Gymnosporangium germinale (Schw.) Kern was reported from New Jersey as occasional.

DISEASES OF STONE FRUITS

PEACH

Brown rot caused by Sclerotinia cinerea (Bon.) Schröt.

Brown rot was very prevalent in most of the peach states in the eastern half of the country during 1919. It was reported from all states where peaches are grown east of the 100th meridian and was present to some extent up and down the Pacific Coast. Rotting of the fruit was the most common and important form of the disease, but in the Middle Atlantic States and New England much damage also was done in the spring by blossom and twig infections. In New York, New Jersey, Delaware, and Maryland blossom blight was extremely serious.

The year 1919 may be said to have been "bad" as far as brown rot was concerned. New England, New York, Ohio, and all states east of the Mississippi and Ohio Rivers reported considerably more than usual, while in the Middle Atlantic States the disease was epiphytotic. In Michigan, Indiana, Illinois, and states west, however, brown rot seemed to be present in about normal or slightly sub-normal amounts.

Estimates of losses from the disease, as it occurred in the orchard, have been made and the percentages are presented on the accompanying map. The losses in bushels will appear in Plant Disease Bulletin Supplement 12, 1920.

It will be noted that in some states the losses were very high. In Delaware 50% reduction in yield is estimated. This is quite largely on account of blossom and twig blight. T. F. Manns estimated that 50% of the blossoms in Delaware were destroyed during the latter part of April. It was so severe in many of the old orchards as to totally destroy the crop. Many cankers which are sure to badly affect the future vigor of the trees, were found. J. M. LeCato made estimates of blighted blossoms in a number of orchards in Sussex County, Delaware, April 28-29. His estimated percentage reductions in yield in individual orchards were as follows: 10%, 10%, 20%, 80% (old orchard), 1% (young orchard), 1% (young orchard), 20%, 5%, 55%, 1-2%, 5%, 75%, 25-80%, 40%, In New Jersey, Cook reported the crop on some trees practically all destroyed from blossom blight. He also stated that it was worse in the old than in the young orchards. He mentioned the cankers on 1918 wood as being a very important source of infection. In New York blossom blight was general in the important peach counties along Lake Ontario. In Wayne County, New York, 50% of the trees were affected, while in Monroe and Orleans Counties as high as 90% blossom infection was reported in individual commercial orchards. In Maryland 90% of the blossoms in some orchards were killed by Sclerotinia in the early spring. In Georgia, brown rot of the fruit was general and caused losses in the field averaging about 20%, but running as high as 100% in some cases. In Louisiana brown rot was serious on what few peaches were grown. One three-acre orchard with a full set of fruit at Avery Island, Louisiana, was a total loss.

The losses from brown rot to fruit in storage, transit, and market were also exceedingly heavy. The best sources of data on this subject are the reports of the food products inspectors of the Bureau of Markets. These men made inspections of 1644 cars of peaches during the calendar year 1919 and found more or less brown rot in about 1150 of these shipments. Table 39 following gives their results more in detail.

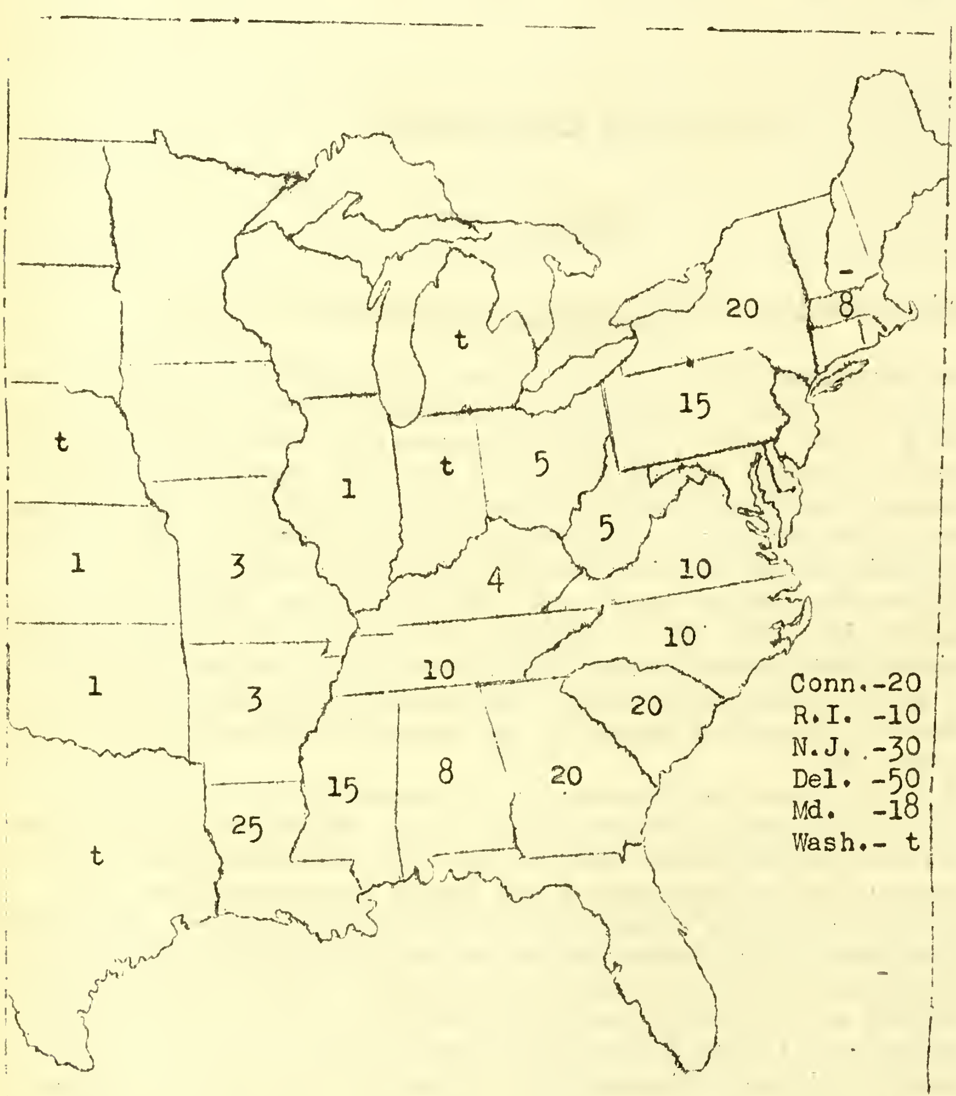

Fig. 29. Estimated percentages loss from peach brown rot, 1919.

Table 39. Percentages of peach brown rot as found in cars at destination by inspectors of the Bureau of Markets, 1919.

Origin of shipment	No. cars with decay	Average % decay	Range of decay		Origin of shipment	No. cars with decay	Average % decay	Range of decay	
			No. cars	Percentage				No. cars	Percentage
Alabama	10	24	7	8-20	New Jersey	5	26	5	10-38
			3	29-60	New York	41	15	36	2-25
Arizona	1	15		5-25				5	38-45
Arkansas	67	14	56	1-25	Ohio	1	5		5
			11	27-50	Oklahoma	65	13	52	1-25
Calif.	6	20		10-30				3	27-45
Colorado	23	11		5-35				4	57-87
Delaware	3	25		12-40	Penn.	10	28	6	6-21
Florida	1	10		3-17				3	35-55
Georgia	615	25	362	1-25				1	80
			219	27-50	Texas	137	17	114	3-25
			34	55-90				18	27-50
Idaho	2	9		5-13				5	52-75
Illinois	7	13		3-30	Utah	28	5		1-21
Indiana	1	10		10	Virginia	5	27		12-40
Maryland	54	15	44	1-25	Washington	4	8		1-13
			10	28-60	W. Virginia	20	29	13	5-25
Michigan	1	30		30				3	30-40
Missouri	38	13	34	1-25				4	55-75
			4	30-80	Unknown	4	39		23-65

Total...1149

Number of cars of peaches inspected...1644

The complaint about the rotting of southern peaches in northern markets was very general last year. Many wholesalers and retailers lost heavily because of brown rot. It will be seen that the aggregate losses from this disease in the field, in transit, and in marketing were enormous.

Warm, moist weather is favorable for brown rot. Although collaborators did not report much about weather conditions, it is known that the wet weather at blossoming time in the Middle Atlantic States induced blossom blight in that section, and that the frequent summer rains favored the development of fruit rot in all the eastern and southeastern states.

The dates when the disease first became evident on the new growth were reported by collaborators as follows:

April	Delaware	(blossom blight)
"	New Jersey	(" ")
"	Arkansas	(" ")
May 15	South Carolina	
" 25	Pennsylvania	(twig blight)
" 26	Alabama	
June	Mississippi	(fruit rot)
June 1	Tennessee	(" ")
June 6	Virginia	(" ")
July	Oklahoma	(" ")
July	Illinois	(" ")

Peach varieties differ considerably in their susceptibility to brown rot. Of commercial varieties it is known that Champion and Carman are very susceptible. The data received on this subject in 1919 is summarized in Table 40.

Table 40. Data on varietal susceptibility of peaches to brown rot, as given by collaborators, 1919.

Variety	State	Remarks as to susceptibility.
Belle of Georgia	Delaware	60% blossom blight in Sussex County.
Carman	Delaware	95% " " " " "
	New York	Badly affected with blossom blight.
	Virginia	50% loss at Warrenton in spite of 3 sprayings.
Champion	Connecticut	Susceptible
	New York	"
	Pennsylvania	100% infection in Adams County.
	Virginia	Especially susceptible.
Early Rochester	New York	Susceptible.
Elberta	Arkansas	Bad blossom blight.
	Delaware	50% blossom blight in Sussex County.
	New York	Susceptible to blossom blight.
Hale	Arkansas	Bad blossom blight.
Niagara	New York	Susceptible to blossom blight.

Self-boiled lime sulphur is commonly used in commercial orchards to combat brown rot. In general it has given good results and has been the means of saving many thousands of bushels of peaches. However, there is still room for much improvement along the lines of an efficient summer spray for peaches. Trials with the use of sulphur and arsenate of lead dust for peach pests have been made during the last few years with rather promising results. In 1918 New Jersey, Delaware, Virginia, West Virginia, and Georgia reported favorably. In 1919 a questionnaire was sent to collaborators asking for "opinions as to the value of sulphur dust in the control of peach diseases" and replies were received as follows:

Connecticut: "Dusting seems to be coming in a little more than past years, but as yet is used in only a limited way." Clinton.

Virginia: "Fully as satisfactory as liquid for curculio and scab, but decidedly inferior for brown rot." Fromme.

West Virginia: "I may say that our opinion has not changed very much as to the value of sulphur dust. I am a little dubious as to its value in controlling peach brown rot." Giddings.

Tennessee: "Sulphur dust used very little, if any, in control of fruit diseases." Essary.

Arkansas: "No data from station tests. Some large orchards have turned out perfect fruit and use only dust." Elliott.

Michigan: "Questionable."

During the season of 1920 a considerable number of dusting experiments will probably be conducted in the East. One of the activities of the Advisory Board of the American Phytopathological Society is a project on dusting orchard fruits under the leadership of N. J. Giddings of West Virginia. A group of pathologists, entomologists, and horticulturists met in Washington March 11, 1920, and drew up a plan for cooperative peach dusting experiments. This plan was distributed to interested persons in the peach growing states, with the hope that they would conduct experiments along the lines of the program, conforming to it as closely as possible.

The experiment was designed to answer such questions as:-,

1. Is the program that is recommended by dust manufacturers, and which is now being used by many orchardists, satisfactory?
2. What is the best formula?
3. Will an additional late application of dust afford better protection?
4. Can reduced quantities of sulphur be used?
5. How can blossom blight be controlled by dust?

The following table is an outline of an experiment planned to help solve some of these questions.

Table 41. Schedule of applications in cooperative peach dusting experiments for 1920, as recommended by the committee in charge of the dusting project of the Advisory Board.

Plot No.	Pink Spray	First Application	Second Application	Third Application	Fourth Application
1.		80-10-10	80-10-10	80-10-10	
2.		0-90-10	80-10-10	80-20-0	
2a.		0-90-10	80-10-10	80-20-0	80-10-10
3.		0-90-10	50-40-10	50-50-0	
4.	Control (sprayed plot)	Arsenate of lead 1.5 lbs lime 3.5 lbs water 50 gal	Self-boiled lime sulphur 8-8-50+2.5 lb arsenate of lead	Self-boiled lime sulphur 8-8-50	

Plot No.	Pink Spray	First Application	Second Application	Third Application	Fourth Application
5.	Check (untreated plot)				
6.	80-10-10	80-10-10	80-10-10	80-10-10	
7.	80-20-0	0-90-10	80-10-10	80-10-0	
8.	50-40-10	0-90-10	50-40-10	50-50-0	

Sulphur - lime - arsenate of lead is the order followed in the above formulae.

Time of application -
Pink spray - when blossoms show pink.
1st application - as calyces are falling.
2nd application - 4-5 weeks after petal fall.
3rd application - one month before ripening.
4th application - seven to ten days before harvest.

Size of plots - about 50 trees in treated plots, fewer in checks.

Materials - 90% of sulphur should go through a 200-mesh sieve.
Best grade of dehydrated lime is essential.
Arsenate of lead should run 80-100 cubic inches per lb.

Machinery - power machines should be used.

Leaf curl caused by Exoascus deformans (Berk.) Fckl.

Peach leaf curl probably had about its usual range in 1919. With the exception of Florida, Louisiana, and some of the dry land states, it was reported from practically all states where peaches are grown. In Georgia it was particularly mentioned as being much more important in the northern than in the southern half of the state.

In general the disease was considerably worse than usual. In many of the eastern states, particularly those along the coast, curl was epiphytotic. New Jersey, Delaware, Pennsylvania, Maryland, and Georgia all reported the worst attack in recent years and collaborators in New York, Ohio, West Virginia, Virginia, Indiana, and Michigan stated that the disease was more prevalent than usual. The abundance of the disease was doubtless attributable to the cold, wet weather early in the spring, which favored infection and made it impossible to apply the dormant spray on time. In many of the states where the disease was bad, it was mentioned that it was prevalent even in sprayed orchards. This was undoubtedly because they were sprayed too late.

Loss estimates have been made by states and will be given in detail in Plant Disease Bulletin, Supplement 12, 1920. The percentage figures are also given in the following table.

Table 42. Estimated percentages by states of the reduction in yield of peaches because of leaf curl in 1919.

States	Per cent	State	Per cent	State	Per cent
Mass.	1	S. C.	2	Mo.	t
Conn.	1	Ga.	7	Nebr.	t
R. I.	1	Ala.	t	Kans.	t
N. Y.	5	Miss.	t	Colo.	*0
N. J.	6	La.	0	Idaho	1
Pa.	5	Texas	t	Wash.	1
Dela.	8	Okla.	t	Ore.	*-
Md.	10	Ark.	t	Calif.	*-
Va.	3	Ohio	3		
W. Va.	5	Ind.	1		
Ky.	1	Ill.	t		
Tenn.	1	Mich.	2		
N. C.	3	Ia.	t		

*- = Occurrence, no data as to loss.
*0 = Occurrence, no loss.

Nearly complete defoliation was reported from some unsprayed home orchards in Delaware and Georgia, and in Massachusetts a case of fruit drop resulting from curl was observed. In Pennsylvania, where the worst outbreak in recent years occurred, an average of 10-25% defoliation was estimated for the state. In Juniata and Erie Counties, Pennsylvania, as high as 90% infection took place.

Varietal differences were not mentioned by collaborators in 1919 except in Tompkins County, New York, it was noted that even those varieties that were supposed to be fairly resistant to leaf curl were rather badly attacked.

The failure of the early spring spray to control leaf curl in a number of states last year is an argument in favor of fall spraying. In the fall the weather and condition of the soil are apt to be much more favorable for spraying than in a cold, wet spring, such as was experienced in 1919.

Scab caused by Cladosporium carpophilum Thüm.

Scab was reported from practically all peach states east of the 100th meridian. It was common and wide-spread in most of these states and seemed to be of most importance in those in the South and East. In general it occurred in about the same amounts as usual, although along the Atlantic Coast from Maryland to Massachusetts it was probably above the average. In New Jersey it was mentioned as doing more damage to the leaves than usual, while in Mississippi it was said to be very abundant both on the 1918, and the current years, twigs.

The losses were brought about chiefly by lowering the market value of the fruit. Collaborators' estimates of injury are given in Table 43.

Table 43. Injury and losses from peach scab according to collaborators in 1919.

State	Percentage affected fruit	Percentage loss	State	Percentage affected fruit	Percentage loss
Arkansas	1	t	Mississippi	20	-
Delaware	5-15	-	Missouri	Moderate	t
Florida	25-30	-	Pennsylvania	-	2-5
Georgia	15	3	South Carolina	20	1
Illinois	t	0	Texas	-	1
Indiana	t	0	West Virginia	10	2
Iowa	t	0			

Considerable amounts of scabby peaches found their way into the markets as is shown by the following table.

Table 44. Percentages of peach scab as shown by inspection of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	No. of cars with scab	Average percentage of scab	Range of percentage of scab	Remarks as to seriousness of scab, etc.
Arkansas	43	14	41 cars 1-3%	
			2 cars 85%	Very bad scab.
Florida	1	27	25-30%	Scab and scars.
Georgia	39	16	37 cars 1-30%	
			2 cars 95%	Almost all stock affected.
Illinois	3	5	1-10%	Slight scab.
Maryland	9	14	5-28%	Other blemishes included.
Missouri	9	23	7 cars 2-18%	
			2 cars 50-100%	Includes hail marks, mildew, etc.
Ohio	1	22	20-25%	Slight scab.
Oklahoma	13	10	2-17%	Includes some insect injury.
Pennsylvania	2	5	5%	Scab found in an occasional basket.
Texas	42	17	40 cars 2-30%	Includes other blemishes.
			2 cars 65-100%	Mostly specks.
Virginia	1	17	15-18%	
West Virginia	3	18	2 cars 2-6%	Scab and other blemishes.
			1 car 50%	Bad scab.

Total.....166 Total number of cars inspected ..... 1644.

Elberta was said to be less affected than Carman in Connecticut, and in Adams County, Pennsylvania, both the Fulton and Greensboro varieties were badly attacked.

Spraying with self-boiled lime-sulphur was satisfactory in Virginia, Georgia, and Arkansas, according to collaborators. Sulphur dust also gave splendid results in a number of eastern states where it was tried. The tests with this material indicate that it will prove to be a very good fungicide for scab control.

Yellows, little peach, rosette, etc. (causes unknown).

Yellows was reported in 1919 from Massachusetts, Connecticut, New Jersey, New York, Delaware, Pennsylvania, and Ohio. A case supposed to be this disease was also reported from Louisiana, but inasmuch as Louisiana is somewhat outside the area where yellows is common, it is possible that the disease was not the true yellows, but rosette or some allied trouble. In New York the disease occurred, especially on Long Island but slight amounts were found locally in the western part of the state. In most of the states it was said to be present in about the usual amount, but in Massachusetts it seemed to be more prevalent than during the last few years.

Few estimates of losses are made, but Delaware estimated 1/2-1% and Pennsylvania 4-5% of the trees affected. The one case reported from Louisiana was a small orchard of 12 trees in Rapides Parish that was a complete failure.

No attempts have yet been made in Pennsylvania to eliminate yellows by an inspection service according to collaborator C. R. Orton.

Little peach was specifically mentioned as occurring in Delaware, New Jersey, and Kansas. The trouble in Kansas may not be the same as that in the other states.

Rosette was reported from Georgia by J. A. McClintock as follows:

> "Found scattered throughout commercial orchards of both young and old trees. Is gradually increasing in commercial orchards as well as in neglected ones. No varietal resistance observed."

The disease was also observed in Oconee and Anderson Counties, South Carolina.

So called "Phony peach" was reported by D. C. Neal from Georgia (Phytopath. Vol. 10: 106-109, 1920). According to Neal the disease has been present for some years in the peach belt of middle Georgia, where it seems to be more or less limited. It was also found on six year old seedlings at Fort Valley, Georgia.

Black spot caused by Bacterium pruni E. F. S.

More or less of this disease occurred rather widely in the South and East. It was reported from New York, New Jersey, Delaware, Virginia, Georgia, Alabama, Mississippi, Texas, Oklahoma, Arkansas, Ohio, Indiana, Illinois, and Missouri. It has never been reported from the Pacific Coast.

It seemed to be of most importance in Delaware, New Jersey, and the southern parts of Indiana, Illinois, and Missouri, and was moderately severe in Oklahoma and Texas. In Indiana it was said to be very prevalent on the wood causing cankers, and on the leaves; while in Illinois it was mentioned as unusually severe on the twigs, but only moderate on the leaves. In both states the fruit spot was not especially common.

The damage, as estimated by some of the collaborators, is as follows: Delaware - 10-15% loss; Georgia - 25% leaves injured; Texas - 1% loss; Arkansas - 1/2% damage. In Roanoke County, Virginia, heavy defoliation and fruit dropping occurred in certain instances. As a rule the disease does little damage in Virginia, however.

That soil fertility is an important factor with this disease is shown by the following quotations:

> Georgia (McClintock): "Spraying seems to be of some value but the more vigorous trees in well cared for orchards appear to be less affected."
>
> Virginia: (Fromme): "Lack of fertility and cultivation favor disease. Prompt application of nitrate of soda was beneficial."
>
> Arkansas (Elliott): "Fertilizer gave good results."

Coryneum blight caused by Coryneum beijerinckii Oudem.

This blight, which is of especial importance on the Pacific Coast, was reported from Washington, Idaho (5% injury, 1/2% loss), Colorado (western part), and Virginia. The occurrence in Virginia seems to be the first on record from that state. According to F. D. Fromme it was found June 1 in two orchards in Roanoke County, where the attack was severe, causing much defoliation with the result that many twigs were with fruit but no leaves. Twenty-five per cent loss of Carmans was estimated in these orchards, while the Elbertas were not so badly affected. The behavior of the disease under Virginia conditions should be closely followed, as the climate is somewhat like that of California, where the disease is very serious. Occurrences should be watched for also in all the eastern states.

Crown gall caused by Bacterium tumefaciens Sm. & Towns.

Crown gall is common on this, one of the more susceptible hosts. It is troublesome on peaches in many nurseries. In 1919 a report from Georgia indicated that much of the nursery stock in that and neighboring states was affected, and that one Georgia nursery showed 50% infection of peach trees. Although the disease occurred widely, it was only reported from New Jersey (common), Delaware, Ohio, West Virginia, Florida, Louisiana, Texas, Oklahoma, Georgia, and Arkansas.

Estimates of damage are as follows:

Delaware	- 1% injury.	Texas	- 1% loss
Georgia	- 10% "	Arkansas	- 2% injury

Black mold rot caused by Rhizopus spp.

This rot was very common in shipments of peaches from all parts of the country, but particularly from the West. While brown rot was the chief market and transit trouble with eastern peaches, black mold rot claimed the greatest toll from the fruit shipped from the western states. In many of these shipments these two diseases were so associated that it was very difficult for inspectors to make any percentage estimates. They were made according to their best judgment and are presented in the following table:

Table 45. Losses from black mold rot as shown by inspection of cars at destination by inspectors of the Bureau of Markets, 1919.

Origin of shipment	No. of cars with decay	Average percentage of decay	Range of percentage of decay	Remarks as to seriousness of decay.
Arizona	1	12	7-18%	Associated with brown rot.
California	8	20	3 cars 30-55%	Brown rot also present.
			5 cars 2-15%	Slight decay.
Colorado	50	8	1-37%	Mostly slight decay.
Florida	2	17	2-32%	Bad decay in one car, slight in other.
Georgia	28	18	3 cars 55-85%	Associated with brown rot.
			3 cars 28-37%	Heaviest decay in top layers.
			22 cars 1-20%	Mostly slight decay.
Idaho	5	5	1-12%	Mostly slight decay.
Illinois	4	6	2-12%	Associated with blue mold.
Maryland	2	32	4-60%	Heavy decay in one load.
Michigan	1	2	2%	Slight decay.
Missouri	3	3	1-5%	Slight decay.
New York	2	2	2%	Slight decay.
Oklahoma	5	6	1-15%	Mostly slight decay.
Oregon	2	7	6-9%	Slight decay.
Texas	5	6	2-14%	Mostly slight decay.
Utah	63	9	3 cars 30-40%	Associated with brown rot.
			60 cars 1-25%	Mostly slight decay.
Washington	29	12	5 cars 32-50%	Heaviest decay in tops of loads.
West Virginia	1	42	10-75%	Accompanied by brown rot.
Unknown	1	17	15-20%	

Total 212

Number of cars inspected 1644

Powdery mildew caused by Sphaerotheca pannosa (Fr.) Lev.

Powdery mildew was reported from South Carolina (local), Texas (trace, unimportant), and Washington.

OTHER DISEASES

Rust, caused by Puccinia pruni-spinosae Pers., was reported from South Carolina (local); Florida (general, unimportant, occurring late); Alabama (general); and Texas (prevalent, unimportant).

Root knot, caused by Heterodera radicicola (Greef.) Mull., was reported from South Carolina and Texas. In the latter state it was not at all important but in South Carolina it was said to be common, affecting a large percentage, (perhaps 40%) of the peach trees all over the state.

Die-back caused by Valsa leucostoma Fr., was reported from Ohio (less); Indiana (rare); South Carolina (local); Oklahoma (one report); and Arkansas (very little this year associated with frost injury).

Frosty mildew caused by Cercosporella persicae Sacc., was reported from South Carolina as common.

Root rots caused by Armillaria mellea Vahl. and Clitocybe monadelpha were general and very severe in Arkansas, where Elliott estimated 1-2% of the trees injured. Many acres of trees were affected and according to Elliott the Clitocybe seemed to be more important than the Armillaria in causing the trouble. In southern Arkansas a great amount of damage was observed by Mr. J. A. Hughes, Horticulturist with the American Refrigerator Transit Co. His report is as follows:

> "Not long ago I visited a twenty acre tract of eight year old peach trees in central Arkansas. The trees are in thrifty condition and heavily loaded with fruit, but about thirty per cent of them are dead, while about thirty per cent show advanced stage of Armillaria. The soil is well drained and a friable clay loam, but the trees were planted on cut over land and the numerous large oak stumps have never been removed. Throughout the entire peach belt of the state wherever the trees have been planted on stumpy or undrained land, root rot plays havoc. The Garner orchard near Cabin Creek of some forty acres has less than fifty per cent of stand and many are still dying."

Armillaria root rot was also reported from Brown County, Indiana.

Leaf spot (non-parasitic) reported from Okanogan County, Washington.

Split pit reported from Walla Walla, Washington.

Water injury was reported from Arizona by J. G. Brown as follows:

> "A loss of about 5000 peach trees in the lower Salt River Valley due to water-logged condition of the soil, has just been reported (July 15). This is a very important matter in connection with irrigation. Its economic importance in a state where the orchard acreage is small is noteworthy."

Spray injury, caused by lime and sulphur with arsenate of lead, was reported from several different points in Connecticut. For some reason there seemed to be more of this than usual in that state.

Frost injury - Late frost at blossoming time in early May killed many blossoms in Connecticut, New York, Michigan, and other states. Frost injury was also very srious in Washington. Clinton in Connecticut reported as follows:

> "Killed blossoms of some varieties more than others. Profusion of bloom, however, gave a fair set in most places. Champion buds winter-killed and failed to blossom, with resulting light crop."

Winter injury - The bad effects of the severe winter of 1917-18 were still evident in 1919. Trees in many orchards in the more northern peach states continued to die and many others remained in a dying or sickly condition. According to Clinton, probably one-half of the trees in Connecticut are now dead or worthless and little replanting is being done.

Not much winter injury took place in the east during the winter of 1918-19, but Idaho and Washington reported considerable damage. In Idaho 20% injury and 5% loss was estimated.

Cat face (non-parasitic) was present in shipments of peaches from Maryland, West Virginia, Texas, Oklahoma, and Arkansas according to market inspectors whose estimates are as follows:

Arkansas - 3 cars with some cat face in each.
Maryland - 1 car with 8%.
Oklahoma - 1 car with 30% cat face and other blemishes.
Texas - 4 cars with small percentage of cat face.
West Virginia - 2 cars with trace to 4% cat face.

PLUM and PRUNE

Brown rot caused by Sclerotinia cinerea (Bon.) Schröt.

Brown rot on plum was reported from practically all states east of the 100th meridian and from Washington and Oregon. Its range was about the same as the disease on peaches except that it occurred farther north on account of the more northerly range of the host.

The most common form of injury was fruit rot but complaints of twig blight were received from Illinois, Kentucky, Iowa, Minnesota, and Washington. Blossom blight was general in New York, and leaf injury was mentioned as occurring in Minnesota.

In general the percentages of loss were highest in the states where brown rot of peach was the worst. Unlike the peach disease, however, it was serious in Michigan and Illinois. Table 46 summarrizes the data on losses as furnished by collaborators.

Apothecia were noted as very abundant at University Farm, St. Paul, Minnesota, early in the spring, and D. F. Fisher reported that, "Apothecia and rainy weather were very prevalent (in lower Williamette and Columbia Valleys of Oregon and Washington), hence conditions were favorable for infection."

Table 46. Injury from plum brown rot in 1919. (Collaborators' estimates.)

State	Percentage crop injured	State loss	State	Percentage crop injured	State loss
Arkansas	10	$5000	New York	-	Heavy
Delaware	-	10-15%	Pennsylvania	-	20-25%
Georgia	5-100	25%	South Carolina	60	15%
Illinois	10	-	Texas	-	1%
Michigan	-	Heavy	Vermont	-	5-10%
Missouri	5-10	-			

The disease was noted in various states on different varieties as follows:

Agen (Petite Prune) - More severely affected than Italian Prune in the Williamette and Columbia River Valleys.
Arch Duke (reported as Late Duke) - Die-back of twigs 4 inches at Lexington, Kentucky.
Pond (Oswego) - Rotted badly in Connecticut.
Sugar - More severely affected than Italian Prune in the Williamette and Columbia River Valleys.
Yellow Egg - Loss of 100% in at least one case in Michigan.
Wild Plums - Reported affected in Minnesota.

Spraying gave only fair control where used in Michigan and South Carolina; and, according to D. F. Fishers, was not very effective on prunes in Washington and Oregon. Copper sprays are mentioned as giving good results in Ohio. Plums do not seem to be very generally sprayed, according to collaborators. Control of the curculio is very important in the prevention of rot.

Pockets caused by Exoascus pruni Fckl.

This disease was reported in 1919 from Ohio, Indiana (twig injury in one orchard), Minnesota, Iowa (rather common), Missouri (occasional), Arkansas (on wild plums), North Dakota, Nebraska, Colorado (general, moderate loss), and California. A local occurrence was also noted in South Carolina.

In California the disease was very destructive in the Sebastopol region last year, where the crop in some orchards was a total loss. Prior to 1919 the disease had been comparatively rare in that region. In Minnesota plum pockets were more prevalent than usual, probably injuring about 2% of the fruit. The Section of Plant Pathology of the Experiment Station in that state reported, "Disease very inconsistent in appearance from year to year. It has not appeared this year in places where it was abundant in 1918. The Surprise, grown quite extensively here, is susceptible. Both lime sulphur and Bordeaux inconclusive."

Black knot caused by *Plowrightia morbosa*. (Schw.) Sacc.

Reports of the occurrence of black knot on plum were received from Connecticut, New York, New Jersey (common), Pennsylvania (prevalent), Delaware (common), West Virginia, Ohio, Kentucky, Indiana, Wisconsin, Minnesota, North Dakota, and Arkansas (on wild plum). It seemed to be maintaining itself in about the average amounts, although in Ohio it caused more trouble than usual. In that state it was said to be especially prevalent in the southern part on damson varieties.

Leaf blight caused by *Coccomyces prunophorae* Higgins.

This leaf disease was reported from New York, Ohio, Michigan, Minnesota (less than 1% loss), Nebraska, and South Carolina (2% loss).

Black spot caused by *Bacterium pruni* E. F. S.

Black spot on the plum was reported from Indiana (general), Illinois, Missouri, Arkansas (common), Kansas, Oklahoma (quite common), and Texas (prevalent). In Illinois it caused considerable loss of foliage and produced many twig cankers which seriously weakened the trees.

Other diseases.

Crown gall caused by *Bacterium tumefaciens* Sm. and Towns. was reported only from Florida and Washington in 1919.

Scab caused by *Cladosporium carpophilum* Thum. seemed to be rather common in southern Missouri. It was also collected in Minnesota on *Prunus americana*.

Wilt, thought to be caused by *Lasiodiplodia triflorae* Higgins, was reported by collaborator Berry as general in Georgia, causing an estimated loss of 15% for the state.

Powdery mildew caused by *Podosphaera oxyacanthae* (Fries.) De Bary was collected in New Mexico in June.

Die-back caused by *Valsa leucostoma* was reported from Ohio (less), and Colorado (general, slight loss).

Rust caused by *Puccinia pruni-spinosae* Pers. was collected in Logan and Payne Counties, Oklahoma.

Heart rot caused by *Fomes fraxinophilus* was reported by D. F. Fisher from Salem, Oregon as follows: "I have found several orchards (prunes) severely affected, the Petite variety more often than the Italian. In some cases every tree is affected and they break under slight strain.

Silver leaf. Leaves showing typical symptoms of this disease were sent to the Michigan Agricultural Experiment Station from Allegan County, Michigan.

Leaf curl, cause uncertain but probably Taphrina, was sent to the Wisconsin Agricultural Experiment Station from Waupaca County, Wisconsin, May 27.

Yellows (cause unknown). Small yellow leaves borne on spindling shoots were observed on Japanese plums in Delaware County, Pennsylvania, September 22.

Chlorosis (non-parasitic). Reported from New Mexico.

Gummosis (cause undetermined) was observed locally in New Mexico. The four trees that were affected died.

Drought spot (insufficient moisture) was reported from Idaho (very serious, causing dropping of fruit before mature), and Washington.

Frost injury. Reported from Washington.

Winter injury. Reported from Washington.

Drop (cause unknown) caused about 10% loss of prunes in Erie County, Pennsylvania.

Fire blight caused by Bacillus amylovorus (Burr.) Trevisan was reported by Coons as destroying 25% of the trees in one orchard in Michigan.

CHERRY

Leaf spot caused by Coccomyces hiemalis Higgins.

Taking the country as a whole, leaf spot was probably much more severe than usual. At least it was more abundant than in 1918. It was reported from Pennsylvania (more), New Jersey (abundant), Delaware (general), Maryland (unusually bad), Virginia (especially severe), West Virginia, South Carolina (common), Georgia (general), Ohio, Tennessee (general), Indiana (very general), Illinois (unsually abundant), Michigan (bad in unsprayed orchards), Wisconsin, Minnesota (on wild plum), Iowa (common), Missouri (general), Arkansas (general and severe), Kansas (local), Idaho (rare), Washington, and California (quite prevalent in Sonoma County).

M. B. Waite, Office of Fruit Disease Investigations, has furnished the following on the occurrence in Maryland and Virginia:

> "This was unusually bad in both Maryland and Virginia this year on both sweet and sour cherry trees, but sweet cherries were not generally so badly attacked as sour varieties. Sour cherries were usually unsprayed, and in many cases, the fruit was reduced in size and rendered almost worthless in quality for marketing. The damage probably exceeded 60% on unsprayed sour cherries in Montgomery County, Maryland, and similar observations were made in Fairfax County, Virginia. Some little spraying was done on sour cherries, and it appeared to be fairly effective against this disease."

Collaborators' estimates of state losses were as follows: Pennsylvania 75% foliage, 3-4% fruit; Delaware - 10% leaves injured; South Carolina - 2% loss; Georgia - 2-3% loss; Indiana - 90% injury; Wisconsin - trace loss; Iowa - 2% injury; 100% locally; Arkansas - 10% injury. In many Michigan orchards the leaves dropped and the cherries developed only to about the size of peas.

Twenty-seven varieties growing at Urbana, Illinois, showed no great differences in relative susceptibility, according to H. W. Anderson.

Spraying seems to be quite successful against this disease. Bordeaux was reported satisfactory in Indiana (2-4-50), and Arkansas.

Brown rot caused by Sclerotinia cinerea (Bon) Schröt.

The range of brown rot on cherry was about the same as on peach and plum. It was reported from most of the cherry producing states in the eastern half of the country and on the Pacific Coast. It was by far the most severe in states along the Atlantic Coast from Georgia northward. Thus, Delaware reported 20% loss; Pennyslvania 10%; New Jersey, very destructive; Virginia, very severe locally; South Carolina, common, 25% injury; and Georgia general, heavy loss. In the states farther west not so much brown rot occurred although it was common and locally destructive in the Mississippi Valley region. West of the 100th meridian the disease did no damage except on the Pacific Coast. In western Washington it was common, causing moderate losses. From the lower Williamette and Columbia Valleys of Oregon and Washington, D. F. Fisher reported that the yield of cherries was often reduced 50% because of the blossom blight form of the disease. He further stated that the loss seemed to be greatest when cherries were in proximity to prune orchards, and that apothecia were found abundantly during the rainy weather of early spring.

The following cherries were reported very susceptible: Oxheart in Indiana, White Oxheart in Pennsylvania, and Queen Anne in Virginia.

The disease was also reported on wild cherries in Washington and South Carolina.

Black knot caused by Plowrightia morbosa (Schw.) Sacc.

Black knot on cultivated cherry was reported from Delaware, Pennsylvania, West Virginia, South Carolina, and Ohio.

It was reported on wild cherry from South Carolina, Minnesota (on Prunus pennsylvanica, P. serotina, and P. virginianae), and Arkansas. This disease probably shows marked differences in the degree to which it affects various varieties of Prunus. An accumulation of more careful notes on varietal susceptibility to black knot should show some interesting and perhaps valuable things. It is hoped that collaborators and others will pay more attention to this phase of the subject during the coming seasons.

Powdery mildew caused by Podosphaera oxyacanthae (Fries) De Bary.

Reported from Pennsylvania (trace, Erie County, August 16); South Carolina (common); Ohio (more); Indiana (local, no loss); Illinois (common); Iowa (very common); Missouri (common); Nebraska, Kansas, and Washington. It was mentioned in a number of states that it was especially common on young shoots, such as suckers and nursery stock.

Other diseases.

Witches broom caused by Exoascus cerasi (Fckl.) Sadeb. - reported from western Washington.

Root rot caused by Clytocybe sp. and Armillaria sp. - trace reported from Arkansas.

Bacterial gummosis caused by Bacterium cerasi Griffin was reported from Washington, and what was thought to be the same was observed in Missouri and Oklahoma.

Gummosis (non-parasitic) was reported by Heald from Washington, and a gummosis of some kind was rather general in Erie County, Pennsylvania, last year.

Silver leaf, said to be caused by Stereum purpureum, was reported by the Section of Plant Pathology as killing one tree on the University Farm at St. Paul, Minnesota.

Die-back caused by Valsa leucostoma Fr. var cincta Rolfs. - Reported from Ohio.

Sap rot caused by Schizophylum commune - Reported from Ohio.

Shot hole caused by Cercospora circumscissa - Reported from Ohio.

Frost injury was much greater than usual in Washington.

Winter injury - Reported from Ohio (much loss), and Washington.

Niter injury caused by excess of nitrates in soil, was reported from Colorado as abundant, causing 10% loss.

APRICOT

Brown rot caused by Sclerotinia cinerea (Bon.) Schröt. was reported from Oklahoma and western Washington.

Scab caused by Cladosporium carpophilum Thüm. was observed in Oklahoma (three occurrences noted), Texas (unimportant), and New Mexico (slight injury).

Coryneum blight caused by Coryneum beijerinckii Oudem. was reported from Idaho and both the eastern and western parts of Washington. Of course, it also occurred in the other Pacific Coast states, but no reports are at hand.

Leaf spots, causes not clear, were observed in Missouri and Texas.

A fruit spot of uncertain cause was reported by Heald and Dana from Washington.

Water injury was reported by J. G. Brown of Arizona as follows: "A loss of about 5000 trees in the lower Salt River Valley due to water-logged condition of the soil, has just been reported. This is a very important matter in connection with irrigation. Its economic importance in a state where the orchard acreage is small, is noteworthy."

ALMOND

Scab caused by Cladosporium carpophilum Thüm. was abundant on the twigs in parts of Mississippi, April 18-26.

Kernel mold caused by Penicillium sp. was reported from Klickitat County, Washington.

DISEASES OF SMALL FRUITS

GRAPE

Black rot caused by *Guignardia bidwellii* (Ellis) V. & R.

This, the most serious disease of the grape, occurred widely over the entire eastern portion of the United States. It was most serious in the southern two-thirds of the country, where warm weather prevailed and where spraying is not generally practiced, and also along the Atlantic Coast where the disease was favored further by abundant moisture. It was mentioned as being considerably worse than usual in the majority of the Coast states. In the commercial areas of New York, Michigan, and northern Ohio, however, where systematic spraying with Bordeaux is practiced, the disease was satisfactorily held in check and an excellent crop of grapes was produced. The extensive vinyards of California do not seem to suffer from black rot.

The extent of the losses is indicated by the following estimates of collaborators:

Connecticut - 10% injury, Pennsylvania - 10% loss, Delaware - 25% injury, West Virginia - 10% loss, South Carolina - 25% loss, Georgia - 10% loss, Florida - 5-50% foliage affected, Alabama - 10% loss, Louisiana - 5-20%, Texas - 5% loss, Arkansas - 5% injury, Kentucky - 5% injury, Illinois - 1/2% loss, Iowa - trace loss, Missouri - 2-50% loss in individual cases. Losses of 75-100% were reported by two growers in Connecticut, and 20, 15, and 25% reduction in yield was observed in three localities in Louisiana. One-half the crop was lost in a one-half acre vineyard in Cape Girardeau County, Missouri; and 30-50% reduction in yield was recorded for York, Huntingdon, and Wyoming Counties, Pennsylvania. In Michigan it was present in some neglected vineyards, causing losses of not over 10%, but the commercial orchards were largely free.

The following dates of first appearance were given by collaborators:

May 7	Florida
May 30	Georgia
May 30	South Carolina
June	Arkansas
June 21	Alabama
June 21	Delaware
June 27	Indiana
June 27	Missouri
July 17	Pennsylvania
August 20	Connecticut

Muscadine grapes were said not to be affected in Georgia, and Concords were mentioned as rotting badly in a number of states.

In general, spraying with Bordeaux was said to give satisfactory results when the fungicide was properly applied. In Delaware, however, many growers claimed to be unable to control black rot with the ordinary grape spraying beams with 4-5 nozzles per row. The Station, therefore, recommended that the spray be directed by hand to the clusters, using two leads of hose with a group of 2-3 nozzles on each.

Downy mildew caused by Plasmopara viticola (B. & C.) Berl. and de Toni.

Downy mildew was more prevalent than in 1919 when it occurred in subnormal amounts. It was reported from Vermont (scarce), Connecticut (more than average), New Jersey (common, not serious), Pennsylvania (more than 1918), South Carolina (common), Louisiana (slight), Texas (trace), Ohio, Kentucky (1% loss at Experiment Station), Illinois (very abundant, 1-2% injury, 1% loss), Minnesota, and Iowa (common).

Powdery mildew caused by Uncinula necator (Schw.) Burr.

Reported from Connecticut (probably average amount), South Carolina (local), Iowa (trace), Missouri (uncommon), Arkansas (common, trace injury).

Anthracnose caused by Gloeosporium ampelophagum Sacc.

Reported from Delaware, Ohio, West Virginia, Mississippi, and Arkansas. According to Manns and LeCato, June 30, the disease caused 50% loss of a heavy set of Concord grapes near Dover, Delaware, while Moore's Early was only about 25% affected.

Other diseases.

Crown gall caused by Bacterium tumefaciens Sm. & Towns. was reported from Delaware (common, 1% injury), Ohio, and New Mexico. It occurs commonly in the vineyards of the Pacific Coast, especially in Oregon and Washington, and apparently varies but little from season to season.

Dead arm caused by Cryptosporella viticola (Reddick) Shear was reported from New Jersey (rare), Pennsylvania (probably less than 1918), Virginia, Ohio (few scattered cases), and Michigan (vineyards sometimes decimated but new growth all right).

Ripe rot, caused by Glomerella cingulata (Stoneman) Sp. & von S., was reported from Delaware as very common and severe, apparently causing large losses, but which, on account of complications with black rot and anthracnose, were very difficult to estimate.

White rot caused by Coniothyrium diplodiella (Speg.) Sacc. was reported to be very severe in the southern part of Illinois, where 1-2% injury occurred, according to H. W. Anderson.

Root rot caused by Ozonium omnivorum Shear was prevalent on heavy lands in Texas according to J. J. Taubenhaus.

A leaf spot thought to be caused by Cercospora viticola was collected in two localities in Ohio.

Lightning killed 3 rows of grapes, each 400 yards long, two miles from Dover in Kent County, Delaware, according to J. M. LeCato, June 28.

STRAWBERRY

Leaf spot caused by Mycosphaerella fragariae (Schw.) Lindau.

In 1919 leaf spot occurred practically everywhere the strawberry was grown. It was reported from the majority of states and for the most part was generally distributed and present in about the average amounts. In Florida and Georgia, however, it was thought to be somewhat less abundant than usual.

In general the percentage of plants injured was rather high, but the actual loss slight. Six states gave estimates of percentage of crop injury as follows: Vermont 10-15%, Delaware 5%, Georgia 5-75%, Minnesota less than 1%, Arkansas 25%, and Colorado 10%. The dates when the disease was first called to the attention of collaborators were:

April 18	Mississippi	June	Oklahoma
May	Arkansas	June	Wisconsin
May 10	Georgia	June 1	Vermont
May 24	Minnesota	June 17	Ohio
May 27	Indiana	June 20	Pennsylvania
May 29	Washington	August 5	Colorado

There seem to be rather marked differences in varietal susceptibility to this disease. In Minnesota, where varietal differences were noted, the disease was said to be severe on the cultivated varieties Superb and Dunlap, and on wild plants. In Illinois the Belt (William Belt) was very susceptible according to H. W. Anderson, and in Texas L. R. Hesler found it to be more abundant on Klondike than on Lady Corneille.

Gray mold rot caused by Botrytis sp.

Gray mold rot was reported in the field only from Connecticut (probably less than usual), Michigan, Wisconsin (trace, where planting was too thick), Minnesota (local), and Louisiana.

Inspectors of the Bureau of Markets examined 81 cars of strawberries from various states and found more or less gray mold rot in 37 of them as follows:

Table 47. Percentages of gray mold rot in shipments of strawberries as found by market inspectors, 1919.

Origin of shipment	No. cars with decay	Average percentage of decay	Origin of shipment	No. cars with decay	Average percentage of decay
Alabama	1	1	Missouri	4	10
Arkansas	8	25	North Carolina	2	15
Delaware	1	t	Ohio	1	--
Kentucky	6	34	Tennessee	7	14
Louisiana	3	20	Wisconsin	1	35
Michigan	2	12	Unknown	1	45

Rhizopus rot caused by Rhizopus nigricans.

This disease was reported by collaborators as being present in the field in Pennsylvania, Mississippi, Louisiana, Texas, Iowa, Nebraska, and Kansas. R. B. Wilcox reported finding it in Ohio but apparently it was only on berries previously injured mechanically. In Iowa the disease was said to be common and severe, and in Kansas it seemed to be the cause of considerable loss as is indicated by the following report of L. E. Melchers:

> "The past season the Rhizopus disease was causing serious injury on immature strawberries. The fruit was attacked and decayed when unripe and before it was ready for picking. It was noticed that wherever the berries touched the ground the disease was serious. Mulching with straw undoubtedly will prevent some of this. Especially on Senator Dunlap and Progressive."

The rot was common in the markets as usual. The following table gives one an idea of the losses it may cause to berries in transit.

Table 48. Percentages of Rhizopus rot in carload lots as found by market inspectors, 1919.

Origin of shipment	No. of cars with rot	Percentages of Rhizopus rot	Place where inspected.
Alabama	2	5-50 in each car	Cincinnati.
Arkansas	6	15,10,17,15,15,15	Des Moines, Detroit, and St. Louis.
Delaware	1	50-55	Cleveland.
Kentucky	3	60-80, 20,20	Chicago and Detroit.
Louisiana	3	10, 40, slight	Kansas City, Detroit.
Maryland	1	25	Pittsburgh.
Michigan	1	30-40	Chicago.
Missouri	2	20-25, 15	Chicago and Indianapolis.
North Carolina	1	8	Philadelphia.
Ohio	2	50,15	Detroit and Cleveland.
Tennessee	3	40,50, some	Chicago and Cincinnati.
Wisconsin	1	35	Milwaukee.

Total cars with Rhizopus rot............ 26
Total cars strawberries inspected 81

Other diseases.

Powdery mildew caused by Sphaerotheca humuli (De C.) Burr. was reported from New Jersey, Nebraska, and Texas.

Nematode - Tylenchus dipsaci (Kühn) Bastian was found at Corvallis, Oregon. (See Byars, L. P., Phytopath. 10: 91-95, 1920).

Leaf blight caused by Phoma obscurans E. & E. was reported by H. W. Anderson as abundant in Illinois, occurring throughout the year. He states that the disease has been confused with the ordinary leaf spot (Mycosphaerella fragariae). The Dunlap variety was quite susceptible in Illinois.

Leaf blotch caused by Ascochyta fragariae was reported from Connecticut where it was about as usual. According to G. P. Clinton this probably did more damage than the Mycosphaerella leaf spot especially on the variety Glen Mary, which, according to him, is very susceptible.

Crown rot, probably due to Rhizoctonia, occurred in Idaho, and undetermined root rots were reported from Alabama (apparently of some importance in some localities), and Wisconsin (local, trace of injury).

Fruit rot, thought to be caused by Rhizoctonia on berries resting on soil occurred in parts of Washington. Some injury to the vines was also reported.

A slime mold did some damage to crop in Nebraska during wet weather.

Drought injury - Connecticut.

Winter injury - Connecticut, New Jersey.

Frost injury - Washington (crop reduced nearly one-half).

RASPBERRY

Anthracnose caused by Plectodiscella veneta Burkholder.

Anthracnose undoubtedly occurred much more widely than is indicated by the reports that were received. These were from the following states: New Jersey, Pennsylvania, West Virginia, Ohio, Indiana, Illinois, Wisconsin, Minnesota, Missouri, Arkansas, Oklahoma, and Washington. In most of these states, particularly those in the central part of the country, the disease was general and the cause of some loss. Regarding the disease in Ohio, R. B. Wilcox, Office of Fruit Disease Investigations has given the following report:

> "Anthracnose was common in nearly all fields, especially on black raspberries of all varieties. Damage hard to estimate. During 1919 the crop was reduced considerably by dry weather during the picking season, and the effect of the drought was much increased by the occurrence of numerous anthracnose spots on the canes. A more tangible effect was the killing and weakening of many tips and buds on young growth late in the season, which will reduce the crop of 1920. Reduction of 1919 crop, probably at least 10%."

The injury in West Virginia was estimated as 10%, in Illinois 1-3%, Missouri 50%, and Arkansas 10%, while the actual loss of black raspberries in Wisconsin was placed at 2-5%.

Black raspberries were much more severely attacked than red varieties. The Sunbeam, Minnesota, and King in Minnesota; the Turner in Wisconsin; and the Cumberland, Kansas Black, and Cardinal in Missouri, are reported susceptible. King and Miller are reported as among the least affected in Wisconsin.

In Wisconsin one grower claimed good results with a dormant spray of lime sulphur 1-20.

Spur blight caused by Mycosphaerella rubina (Pk.) Jacz.

This disease was reported from Connecticut, (probably usual amount), Illinois (abundant on all red varieties observed), Ohio (general), Wisconsin (trace on blacks, general and slight on reds), and Washington (Pierce and Thurston Counties).

R. B. Wilcox of the Office of Fruit Disease Investigations, reported for Ohio as follows:

> "Spur blight occurred generally on both red and black varieties, most abundantly on the former, though apparently not doing much damage there. Considerable damage to some fields of blacks, especially of the Kansas variety, though mostly in the way of killing buds and spurs, thus reducing the 1920 crop. Average damage very small."

In Minnesota it was found on wild as well as cultivated raspberries. The following varieties are listed as susceptible in that state: Turner, Sunbean, Minnesota, King. In one case Cuthbert and Louden were not attacked, while King, in the same row with them, was affected. In Wisconsin R. E. Vaughan reported Marlboro as least affected of the red varieties.

Cane blight caused by Leptosphaeria coniothyrium (Fckl.) Sacc.

Cane blight occurred on red and black raspberries in New Jersey, Delaware, West Virginia, Ohio, Indiana, Illinois, Wisconsin, Arkansas, and Idaho. As a whole it did not do much if any damage, although 10% injury in Delaware, 5% in Arkansas, and 1% or less in West Virginia was reported.

Yellows (cause unknown).

Yellows was reported from Connecticut (one report), Pennsylvania, Ohio, Indiana (rare), Wisconsin (scattered on black, and general on red raspberries), Minnesota (probably very general), and Colorado (slight). In Pennsylvania as high as 50% of the crop was injured more or less in two counties. Collaborator C. R. Orton reported the disease to be present in most of the old red raspberry patches, but usually not recognized by the owners.

In Ohio R. B. Wilcox reported, "Common on all red varieties noted, and found occurring in a few fields of blackcaps of the Cumberland variety. Injury to blacks negligible; to reds probably 10%."

Cuthbert was reported susceptible in Pennsylvania.

Leaf spot caused by Septoria rubi Westd.

This disease was of slight importance according to the reports from Connecticut, New Jersey, Ohio, Wisconsin, Minnesota, Missouri, and Oklahoma.

Orange rusts caused by Gymnoconia interstitialis (Schlecht.) Lagerh. and Kunkelia nitens.

This was reported to the survey as follows: Connecticut (I stage, long cycle, about as usual), Indiana (very prevalent early in season), Illinois (occasionally observed), Wisconsin, Minnesota, Nebraska, Oklahoma (Early Harvest least susceptible, McDonald most), Iowa (common, one plantation plowed up because of rust), and Washington.

Other diseases.

Crown gall caused by Bacterium tumifaciens Sm. & Towns. was common on raspberries. It was reported from New Jersey, Delaware, Ohio, Illinois, and Wisconsin. Injury of 10-12% was estimated in Delaware, 2-5% in Illinois, and in Wisconsin it was considered one of the important diseases. R. B. Wilcox reported from Ohio:

> "Very common, though severe in only a few plantations. Especially destructive to reds. Damage impossible to estimate; possibly 5% on reds, 1% on blacks; these figures can only be guesses. Per cent of infection, of course, much higher than this."

The variety Turner was said to be most and the St. Regis least resistant in Wisconsin.

Rust reported as caused by Phragmidium imitans was collected in Washington.

Powdery mildew caused by Sphaerotheca sp. was observed in Ohio and Minnesota.

Fruit rot caused by Botrytis sp. was reported from Minnesota and Washington.

Sun scald caused by intense sunlight was rather general in parts of Colorado, causing slight injury.

BLACKBERRY, DEWBERRY, AND LOGANBERRY

Orange rusts caused by Gymnoconia interstitialis (Schlecht.) Lagerh. and Kunkelia nitens.

In 1919 one or the other of these rusts were reported from practically all states in the eastern half of the country (east of the 95th merician), and from Washington. Most of these states indicated that rust was very common, especially on wild blackberries. Susceptible, cultivated varieties were also severely affected in some places. In parts of Ohio, R. B. Wilcox reported as high as 10% infection in some fields, while it was absent in others.

The dates when the first reports of rust were received were given by collaborators as follows:

April - Arkansas
May - South Carolina
May - Georgia
May 10 - Illinois
May 12 - Washington
May 19 - Missouri
May 27 - Pennsylvania
May 28 - Indiana
June 9 - Minnesota
June 12 - Ohio
June 15 - New Hampshire

In the District of Columbia the disease appeared on the first young leaves of wild blackberries shortly after they emerged from the buds.

Notes on the resistance of varieties to rust were furnished by two collaborators as follows;

> *Georgia:* "Few cultivated berries in Georgia. Perhaps more would be grown if rust was not so serious. Am testing some resistant dewberries with good results." McClintock.

> *Illinois:* "In a patch at Urbana, LaGrange, and Snyder were planted side by side. The LaGrange rusted so badly that they had to be dug out, while the Snyders were entirely free from the disease. La Grange is not regarded as being as susceptible as Early Harvest." H. W. Anderson.

Leaf spot caused by *Septoria rubi* Westd.

This spot was reported from New Jersey, Pennsylvania, Ohio, Wisconsin, Minnesota, Iowa, Missouri, Mississippi, Texas, Washington, and California. In general it was unimportant, but in California the combination of this disease and weather conditions has caused considerable damage to blackberries, raspberries, and loganberries during the last two seasons.

Anthracnose caused by *Plectodiscella veneta* Burkholder.

On blackberry this disease was reported from New Jersey (also on dewberry), Delaware, Ohio, Wisconsin, Illinois, Missouri, Kansas, and Washington. It was common in the first four of these states, but seemed to be of economic importance in Delaware, where it was severe in some sections.

Other diseases.

Crown gall caused by *Bacterium tumefaciens* Sm. & Townes. was reported from Ohio (occasional), Texas, Wisconsin, Minnesota, and Washington. It was reported important only in Wisconsin, where it was said to be the limiting factor in production in the largest blackberry section.

Powdery mildew caused by Sphaerotheca humuli (De C.) Burr. was reported by R. B. Wilcox, Office of Fruit Disease Investigations from Cuyahoga, Loraine, and Lake Counties, Ohio as follows: "Very prevalent late in summer. Great differences in severity on different varieties, the Taylor, Ward, and Blowers being worst, in the order named, while Wilson and Snyder were rather resistant. Eldorado (most commonly grown) moderately affected. Little damage."

The disease was also reported from Minnesota.

Double blossom caused by Fusarium rubi Winter - common in New Jersey, Delaware, Mississippi, and Louisiana. In the two latter states it was noticed in April, especially on wild plants.

Cane blight caused by Leptosphaeria coniothyrium (Fckl.) Sacc. - reported from Ohio and Wisconsin (one occurrence in Monroe County).

Spur blight caused by Mycosphaerella rubina (Pk.) Jacz. was collected in one place in Outagamie County, Wisconsin.

Leaf blight, thought to be of bacterial nature, was reported from Pierce County, Washington.

CURRANT

Leaf spot caused by Mycosphaerella grossulariae (Fr.) Lind. occurred in Pennsylvania, New Jersey, Ohio, Minnesota, Iowa, and Missouri. It also doubtless occurred in many other states although these were the only ones from which it was reported. In years prior to 1919 reports were received from the additional states of Maine, Vermont, Massachusetts, New York, Delaware, Maryland, Indiana, Michigan, Wisconsin, Iowa, South Dakota, Arkansas, and Washington.

Anthracnose caused by Pseudopeziza ribis Klebahn was reported only from Minnesota, where it was collected on Ribes aureum, R. vulgare, and R. americanum.

Blister rust caused by Cronartium ribicola Fisch. von Waldh. - Reported by collaborators in New Hampshire, Vermont, (wide spread), Connecticut (on several species of Ribes), New Jersey (two species of Ribes), and Minnesota.

Cane blight caused by Botryosphaeria ribis Grossenbacher and Duggar was common and destructive inparts of New Jersey and very destructive in Cuyahoga Couty, Ohio, on some plantations.

Angular leaf spot caused by Cercospora angulata Winter - Reported as common in Iowa, causing defoliation in cases.

Cane blight caused by Nectria sp. was reported from Minnesota, North Dakota, and New Mexico.

Die-back caused by Botrytis sp. reported from Washington and California.

Rusts. Miscellaneous rusts were collected on Ribes in Minnesota and Connecticut. In the later state G. P. Clinton reported the collection of Aecidium grossulariae on black currant for the first time on that host. It occurred on both leaves and fruit.

Gloeosporium ribis (Lib.) M. & D. was reported very common in New Jersey.

GOOSEBERRY

Powdery mildew caused by Sphaerotheca mors-uvae (Schw.) B. & C. - Reported from Missouri, Iowa (on wild gooseberry), Colorado (slight), Idaho (fairly common; about 5% loss), and Washington.

Leaf spot caused by Mycosphaerella grossulariae (Fr.) Lind. - Reported from New Jersey (common), Ohio (less), Minnesota, and Missouri.

Anthracnose caused by Pseudopeziza ribis Klebahn was reported from New Jersey (common), Minnesota, and Washington.

Blister rust caused by Cronartium ribicola Fisch. von Waldh. - Reported widespread in Vermont (see also currant page 170 and pine in later report).

Rusts of various kinds were reported from Ohio, Minnesota, Iowa, and North Dakota.

Die-back caused by Botrytis sp. was reported from Pierce County, Washington.

Sun scald of fruit on bushes was rather general in Cuyahoga County, Ohio, according to R. B. Wilcox. In some plantations nearly all fruit on bushes was ruined during the hot weather of July 3-4.

CRANBERRY

C. L. Shear, Bureau of Plant Industry, has kindly furnished the following report on the cranberry disease situation in 1919:

> "The season of 1919, while not showing any unusual amount of disease and rot in the field, showed much more rot and spoilage during distribution and marketing. This was true not only of the fruit from New Jersey, Massachusetts, and Wisconsin, but also from the Pacific Coast. Just what the cause was, is uncertain. It may have been due to unusually favorable climatic conditions for the development of rot after picking or to the unusual amount of infection of fruit during the growing season.
>
> "Early rot casued by Guignardia vaccinii, bitter rot caused Glomerella cingulata vaccinii, end rot caused by Fusicoccum putrefaciens, and ripe rot by Sporonema oxycocci were very prevalent in eastern berries. On the Pacific Coast the most important rot occurring in our examinations of fruit seemed to be end rot.
>
> "The red leaf spot caused by Exobasisium vaccinii, Sclerotinia, and a black spot disease caused by an unnamed organism, were prevalent in some particular bogs rather seriously."

The actual percentages of decay found in carload shipments of cranberries by market inspectors is shown in the following table.

Table 49. Losses of cranberries from decay as shown by inspection of cars at destination, 1919.

Origin of shipment	No. of cars with decay	Average percentage of decay	Range of percentage of decay
Massachusetts	19	18	5 cars 28-48 14 cars 5-22
New Jersey	5	8	7-10
New York	1	17	17
Pennsylvania	1	7	7
Wisconsin	1	4	4
Total.................... 27		Number of cars inspected - 37	

MULBERRY

A bacterial blight, possibly caused by Bacillus mori, was reported from Erie County, Pennsylvania, by J. H. Muncie, and from Madison County, Indiana, by M. W. Gardner.

Root rot caused by Ozonium onmivorum Shear occurred on mulberry in Texas according to Taubenhaus.

A blight of unknown cause was reported from Fulton County, Ohio.

DISEASES OF SUB-TROPICAL FRUITS

CITRUS

Scab caused by Cladosporium citri Massee.

Scab was reported from Florida and Porto Rico. In Florida, where there was more scab than during the previous season, it was generally distributed, causing losses to grapefruit as high as 50% in local instances. Nine cars of Florida grapefruit inspected at Boston November 15-28, 1919, were reported by market inspectors as showing the following percentages of scab: 15-20, 15-20, 10, 10, 8, 8-10, 12, 20, and 20.

Scab in Porto Rico was said to be on the increase causing varying amounts of loss.

Melanose caused by Phomopsis citri Fawcett.

According to H. E. Stevens this disease was generally distributed in Florida citrus groves and was more abundant than usual because of the wet summer. In some instances from 1-50% of the fruit was injured. The disease merely disfigured the fruit so that the loss consisted chiefly in a reduced selling price. Considerable loss was sustained, however, by this fungus

Table 50. Stem end rot of citrus caused by Phomopsis citri and Diplodia sp. as found by market inspection of carload shipments from Florida in 1919.

Grapefruit			Orange		
Place of inspection	Date	Per cent rot	Place of inspection	Date	Per cent rot
Buffalo	Jan. 11-13	2			
		4			
		9	Pittsburgh	Jan. 6	18
Houston	" 29	4	Boston	" 21	15
Buffalo	Feb. 5	t	New York	" 28	t
	5	t	Boston	" 29	6
Cleveland	Mar. 15	2	Houston	" 29	13
Fort Worth	" 19	3	Pittsburgh	Mar. 12	4
Detroit	Apr. 24	3	Chicago	" 22	45
Chicago	Oct. 1	8	Jacksonville	" 26	25
Dallas	" 9	5	New Orleans	Oct. 20	11
Minneapolis	" 28	16	Milwaukee	" 24	8
	" 29	24	Cincinnati	" 29	8
Detroit	Nov. 3	15	Pittsburgh	Nov. 1	6
Chicago	" 5	2	Chicago	" 1	10
	" 6	2	Atlanta	" 5	3
	" 11	17		" 6	12
Kansas City	" 8	5	Boston	" 12	6
Minneapolis	" 8	8	Baltimore	" 13	25
Boston	" 24	3		" 15	35
Chicago	" 17-18	13	Buffalo	" 17	5
Cleveland	" 17-18	10	Chicago	" 20	48
Denver	" 17-18	6	Pittsburgh	Dec. 4	10
Minneapolis	" 17-18	7	Buffalo	" 9	33
Pittsburgh	" 19	3	Pittsburgh	" 11	3
Dallas)	" 20-21	10		" 12	10
Denver)	"	8	Chicago	" 19	7
St. Paul)	"	7	Fort Worth	" 24	6
		4	Cincinnati	" 23	9
		3	Columbus	" 23	2
		2	Washington	" 31	2
Cincinnati	Dec. 8	4			
Indianapolis	" 11	4			
Boston	" 30	10			
Total No. cars - 34		6.6 (Av.)	Total No. cars - 29		13.3(Av.

(Phomopsis citri) causing stem end rot of citrus fruits both in the orchard and during transportation and marketing. Stevens reported this phase of the disease about as usual in the field. Local instances were noted where 5-50% of the fruit was attacked. Stem end rot caused by this fungus and by Diplodia was found in shipments from Florida, Porto Rico, and Cuba. The percentages in Florida shipments are given in Table 50.

Wither tip and anthracnose caused by Colletotrichum gloeosporioides Penz.

Wither tip and anthracnose were reported by H. E. Stevens as occurring about as usual in Florida. The disease of the fruit was found by market inspectors as shown in the accompanying table.

Table 51. Anthracnose of citrus fruits found in commercial shipments, 1919.

Fruit	Origin of shipment	No. cars	Place of inspection	Per cent anthracnose
Grapefruit	Florida	3	Buffalo	Trace in all cars.
		1	Jacksonville	8% in 2 boxes, 28% in remainder.
Lemon	Italy	1	Jacksonville	6% affected fruit of which 10% was a loss.
Orange	Florida	1	Jacksonville	About 1%.
	California	1	New York	18-20% fruit infected with 2-8 spots on each.
	Unknown	1	Chicago	15% affected. Spots one inch to one-third the surface in size.

Blue mold rot caused by Penicillium sp.

This disease probably caused more loss of citrus fruits, particularly lemons, than any other rot affecting the fruit during the process of marketing. Figures obtained from the market inspectors' certificates of inspection indicate that about one out of every ten lemons they examined were affected with this rot, that about six out of every hundred oranges and three out of every hundred grapefruit were likewise affected with blue mold.

Table 52. Blue mold rot in shipments of citrus as determined by inspectors of the Bureau of Markets, 1919.

Source	Orange		Grapefruit		Lemon	
	No. cars with rot	% rot	No. cars with rot	% rot	No. cars with rot	% rot
Arizona	2	10	-	-	-	-
California	153	8	5	23	61	13
Florida	101	14	58	8	-	-
Texas	-	-	1	6	-	-
Cuba	-	-	1	5	-	-
Italy	-	-	-	-	5	17
Unknown	3	4	-	-	-	-
Total	259		65		66	
Average % rot in cars with decay		10.7		8.9		13.4
Total no. cars inspected	449		155		87	
Average % rot in all cars inspected		6.2		3.7		10.2

Other diseases

Scaly bark caused by *Cladosporium herbarum* var. *citricolum* Fawcett, occurred in slight amounts as usual in Florida. It was localized and confined chiefly to Volusia, Brevard, Osceola, Polk, De Soto, Manatee, Pinellas, and Hillsboro Counties.

Foot rot caused by *Phytophthora terrestria* Sherb. occurred about as usual in Florida and "was confined mostly to sweet seedling groves and trees on Rough Lemon stock."

Gummosis (cause unknown) was more or less widely distributed in the northern part of the citrus belt in Florida.

Center rot caused by *Alternaria* sp. was found in 10 of the 87 cars of California lemons inspected, causing an average of 11% decayed fruit. The decay occurred in all stages from slight to complete and affected from 2-30% of the lemons. One car of California oranges also was reported as showing an occasional orange affected with Alternaria.

Brown rot caused by *Pythiacystis citrophthora* was found by inspectors in at least two cars of California lemons and one car of California oranges.

Stem end rot caused by *Diplodia* sp. - (See Table 50.)

PINEAPPLE

Fruit rot caused by Thielaviopsis paradoxa (DeSeyn.) v. Hohn.

This was the only pineapple disease of consequence brought to the attention of the Survey in 1919 and practically all of the reports that were received concerned Cuban fruit inspected in some of our larger cities. The following table shows the situation in some detail.

Table 53. Losses to Cuban pineapples from fruit rot in individual cars as shown by markets inspection, 1919.

Place where inspected	Date of inspection	Percentages of decay in individual cars	Severity of decay.
Chicago	Jan. 8	55	Some crates showed 30-85%, mostly complete decay.
"	Feb. 9	45	Range 15-70%.
"	Mar. 12	47	Two-thirds complete decay.
"	" 13	37	Three-fourths " "
"	" 15	22	Two-thirds " "
"	Apr. 14	40	One-half " "
"	" 14	55	" " "
"	" 14	60	" " "
"	" 16-18	25	Mostly complete decay.
"	" 16-18	33	" " "
Columbus	" 16-18	40	" " "
"	" 16-18	45	" " "
Chicago	May 5	30	Range 15-65%, 20% complete.
Milwaukee	" 21	10	Affected about 1/2 of each fruit.
"	" 22	6	" " 1/3 " " "
Omaha	" 23	6	Mostly complete.
"	" 23	7	" "
"	" 27	20	" "
Milwaukee	" 28	8	Fruit spotted, occasional complete decay.
Pittsburgh	" 28	15	
New Orleans	" 31	16	
Columbus	" 31	8	
"	June 3	6	Complete decay.
"	" 3	9	" "
"	" 6	15	Mostly complete decay.
"	" 9	10	" " "
"	" 9-11	25	" " "
"	" 9-11	5	" " "
"	" 9-11	5	" " "
Flint, Mich.	" 10	30	Complete decay.

Pleae where inspected	Date of inspection	Percentages of decay in individual cars	Severity of decay.
Rochester	June 10-12	22	Mostly complete decay.
"	" 10-12	10	One-third bad decay involving 1/3 of each fruit.
Des Moines	" 10-12	21	" " " "
"	" 10-12	30	" " " "
Columbus	" 11	9	Mostly complete decay.
"	" 11	13	" " "
Washington	" 13	48	One-half complete decay.
Columbus	" 16	17	Four-fifths completedecay.
Kansas City	" 16	24	
"	" 16	35	
Columbus	" 18	17	Mostly complete.
Pittsburgh	" 19	15	Affected 1/2 of each fruit.
New Orleans	July 23	37	" " " " "
Chicago	Nov. 11	55	Mostly complete decay.
Cincinnati	Dec. 22	12	Mostly at stem end.

FIG

Rust caused by *Physopella fici* (Cast.) Arth. (*Uredo fici* Cast.) was reported from Florida (general; loss not so important, occurred late, first report July 3), Alabama, and Texas (prevalent).

Anthracnose caused by *Glomerella cingulata* (Stoneman) Sp. and Von S. reported from Louisiana (scattered, damage slight) and Texas (Harris County). What was probably the same trouble was reported as Colletotrichum from Florida where it was the cause of occasional loss in Volusia and Gadsden Counties.

Canker caused by Macrophoma - Texas.

Leaf blight caused by Rhizoctonia - Florida.

Leaf spot caused by Cercospora - Hawaii.

DATE

Leaf smut caused by *Graphiola phoenicis* (Norig.) Poit - Reported from Texas.

Leaf spot caused by *Exosporium palmivorum* Sacc. - Reported from Harris County, Texas, as occurring in traces and unimportant.

BANANA

Wilt caused by Fusarium, probably *cubense inodoratum* (E. F. S.) Brandes occurred in Porto Rico in the usual amounts, causing about 25% injury to the crop, according to J. Matz.

Freckle caused by *Phoma musae* Carpenter - was reported by Carpenter from the Island of Oahu of the Hawaiian group. The disease attacked the Chinese or dwarf banana almost exclusively, causing serious damage to fruit and leaves. Spraying experiments are being conducted.

LOQUAT

Blight caused by *Bacillus amylovorus* (Burr.) Trevisan reported as common in Louisiana, injuring a large percentage of trees but causing only slight actual loss.

AVOCADO

Scab caused by *Cladosporium* sp. was reported about as prevalent as usual but somewhat more common on the fruits than is ordinary. Locally it was considered severe. First report was in April.

Fruit spot caused by *Colletotrichum* sp. was reported by H. E. Stevens as causing more injury than usual, injuring 10-90% of the crop in local instances. First reported in July.

DISEASES OF NUTS

PECAN

Scab caused by *Fusicladium effusum* Wint.

Apparently scab was very common in the Southern states on pecan last year. Reports of its occurrence were received from South Carolina, Georgia, Florida, Alabama, Mississippi, and Louisiana. Losses of 10 and 5% were estimated in South Carolina and Georgia respectively. Susceptible varieties were reported from Georgia as follows: Van Diemer, Mobile, Delmas, and Georgia Giant. The Delmas was also reported susceptible in Alabama.

Powdery mildew caused by *Microsphaera alni* (Wallr.)

Reported common in South Carolina (2% loss), Georgia, Alabama (loss small), and Mississippi (small loss).

Rosette (non-parasitic).

This disease was reported by states as follows:

Alabama: General. Reports from Washington, Marengo, Pike, and Houston Counties.
Arkansas: Reported from southwestern part of state. It is severe on some of the river bottom plantations where hardpan prevents the rise of ground water during dry season. Less on sandy than on dark rich soils.
Georgia: General, about 5% loss in state.
South Carolina: Common, about 5% loss.

Other diseases.

Crown-gall caused by *Bacterium tumefaciens* Sm. and Towns. - Alabama.
Anthracnose caused by *Glomerella cingulata* - Georgia.
Leaf spot caused by *Cercospora* sp. - Louisiana.

WALNUT

Bacterial blight caused by *Bacterium juglandis* was reported from Alabama and New Jersey. In the latter state it was abundant on English walnuts and the cause of many inquiries, according to M. T. Cook.

Crown-gall caused by *Bacterium tumefaciens* Sm. and Towns. - Reported from Clarke and Pierce Counties, Washington.

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THE PLANT DISEASE BULLETIN

Issued By

THE PLANT DISEASE SURVEY

SUPPLEMENT 10

Diseases of Field and Vegetable Crops in the United States in 1919

June 1, 1920

BUREAU OF PLANT INDUSTRY

UNITED STATES DEPARTMENT OF AGRICULTURE

PLANT DISEASE SURVEY

1919

G. R. Lyman, Pathologist in Charge.

R. J. Haskell, Asst. Pathologist. G. H. Martin, Jr., Asst. Pathologist.

List of Collaborators of the Plant Disease Survey who have made the principal contribution to the 1919 annual summary.

It should be understood that many other collaborators and pathologists have assisted in gathering data within the states but the following list includes those who actually furnished state reports to the Washington office.

Alabama	Dr. G. L. Peltier
	Dr. E. F. Hopkins
Arizona	Prof. J. G. Brown
Arkansas	Dr. J. A. Elliott
	Prof. H. R. Rosen
Colorado	Prof. J. G. Leach
Connecticut	Dr. G. P. Clinton
Delaware	Dr. T. F. Manns
	Prof. J. M. LeCato
Florida	Dr. H. E. Stevens
	Dr. C. D. Sherbakoff
Georgia	Prof. J. B. Berry
	Prof. J. A. McClintock
Idaho	Prof. C. W. Hungerford
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	Prof. G. H. Dungan
Indiana	Dr. M. W. Gardner
	Prof. H. S. Jackson
	Dr. G. N. Hoffer
Iowa	Dr. I. E. Melhus
	Dr. R. O. Cromwell
Kansas	Prof. L. E. Melchers
	Prof. H. H. Haymaker
Kentucky	Dr. W. D. Valleau
Louisiana	Dr. C. W. Edgerton
Maine	Dr. W. J. Morse
Maryland	Prof. C. E. Temple
Massachusetts	Prof. A. V. Osmun
	Mr. W. S. Krout
Michigan	Dr. E. A. Bessey
	Dr. G. H. Coons
	Mr. Ray Nelson
Minnesota	Dr. E. C. Stakman
	Dr. G. R. Bisby
Mississippi	Prof. J. M. Beal
Missouri	Dr. W. E. Maneval
	Prof. C. H. Philpott
Montana	Prof. D. B. Swingle
	Dr. H. M. Jennison
	Prof H. E. Morris
Nebraska	Dr. E. M. Wilcox
Nevada	Prof. C. W. Lantz
New Hampshire	Dr. O. R. Butler
New Jersey	Dr. M. T. Cook
New Mexico	Prof. L. H. Leonian
New York	Dr. Chas. Chupp
North Carolina	Dr. R. A. Jehle
North Dakota	Prof. H. L. Bolley
Ohio	Prof. A. D. Selby
	Prof. W. G. Stover
Oklahoma	Prof. C. D. Learn
Oregon	Prof. H. P. Barss
	Prof. C. E. Owens
Pennsylvania	Prof. C. R. Orton
Porto Rico	Mr. Julius Matz
South Carolina	Prof. J. L. Seal
South Dakota	Prof. Manley Champlin
Tennessee	Prof. S. H. Essary
Texas	Dr. J. J. Taubenhaus
Utah	Dr. G. R. Hill, Jr.
Vermont	Dr. B. F. Lutman
	Prof. A. H. Gilbert
Virginia	Dr. F. D. Fromme
Washington	Dr. F. D. Heald
	Mr. B. F. Dana
	Mr. A. M. Frank
West Virginia	Dr. N. J. Giddings
	Prof. Anthony Berg
	Dr. J. L. Sheldon
Wisconsin	Dr. R. E. Vaughan
	Prof. W. H. Wright

DISEASES OF FIELD AND VEGETABLE CROPS IN THE UNITED STATES IN 1939.

Prepared by

R. J. Haskell and Miss Jessie Wood.

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PRELIMINARY STATEMENT

Sources of Information.

This summary has been made possible by the receipt of a large number of reports on diseases gathered from various sources.

1. The collaborators of the Plant Disease Survey have supplied by far

the greatest amount of information. On June 1, 1920 collaborators numbered 96 and of these 46 were acting as chief collaborators for their resepctive states. All of these persons are paid only nominal salaries so that whatever contributions they make are largely voluntary. In most cases the chief collaborators sent in reports, but in some cases other persons were designated to prepare and submit the state summary. The list of names on the cover page are those of persons who made most of the reports to the Washington Office.

2. Plant pathologists of the Bureau of Plant Industry, particularly in the Office of Cotton, Truck and Forage Crop Disease Investigations, have contributed valuable information. In many cases their reports have already appeared in mimeographed form in the News Notes of the Office of Cotton, Truck and Forage Crop Disease Investigations, from which quotations have been made frequently in the following pages. The notes from Mr. D. G. Milbrath in California were esepcially helpful as these constituted most of the data received from that state. The quotations from Dr. G. K. K. Link on market diseases are also noteworthy.

3. The food products inspectors of the Markets Inspection Service conducted by the Bureau of Markets have collected a mass of data during 1919. These inspectors, of whom there are nearly 50 in number, located in about 24 of the larger cities, examine shipments of fruit and vegetable products on request of persons vitally concerned and prepare certificates giving the results of their inspection in detail. These certificates, showing the exact condition of the loads when they arrive at destination are filed in Washington with the Bureau of Markets and are made available to the Plant Disease Survey. During 1919 we have examined all of these certificates and extracted those data which show the percentages of decay of various kinds of fruit and vegetable rots. The results of this work are presented in the following pages. For the most part, they take the form of tables.

4. Miscellaneous reports, letters, extracts from publications, papers, etc., have been made during 1919 and some of the information gathered in this way has been used in preparing this summary.

The estimates of losses are largely those of collaborators, but plant pathologists of the Bureau of Plant Industry have also assisted and considerable revision has been made in the Plant Disease Survey Office. The estimates are necessarily rough but it is felt that they are an improvement over those of other years and are about as accurate as can be obtained at this time. The Survey has in preparation Supplement 12 of the Plant Disease Bulletin, which deals with crop losses from plant diseases during 1919. In this supplement percentage loss and also the reduction yield in bushels has been given. In some cases the figures in that supplement will not check with those in this present summary. This is on account of further revision of estimates. The figures in Supplement 12 are, therefore, the most accurate.

The Plant Disease Survey wishes to express its thanks to the collaborators and plant pathologists of the Department of Agriculture who have assisted in the preparation of this report by furnishing notes from time to time. It is hoped that even more persons will assist in the work of accumulating plant disease information during the present season and will send it in to the Plant Disease Survey for summarizing during the winter of 1920.

DISEASES OF POTATO

Late blight caused by Phytophthora infestans (Mont.) De Bary.

On the late crop, blighting of the vines and the accompanying rot were general in the northeastern part of the country as far west as Ohio and extending down the Appalachians as far as Northern Georgia. On the early crop the disease occurred destructively in Florida and somewhat along the coast in Georgia. Early potatoes farther north escaped blight for the most part.

The only other area of importance was that in Northern Wisconsin. Spotted occurrences were reported from South Dakota, the Upper Peninsula of Michigan, Ohio, and California, and certificates of market inspectors show late blight rot in shipments from Illinois, Iowa, Minnesota, Washington, and Oregon, although these reports were not substantiated by observations in the field. The accompanying map shows the range as reported to the Survey during the year.

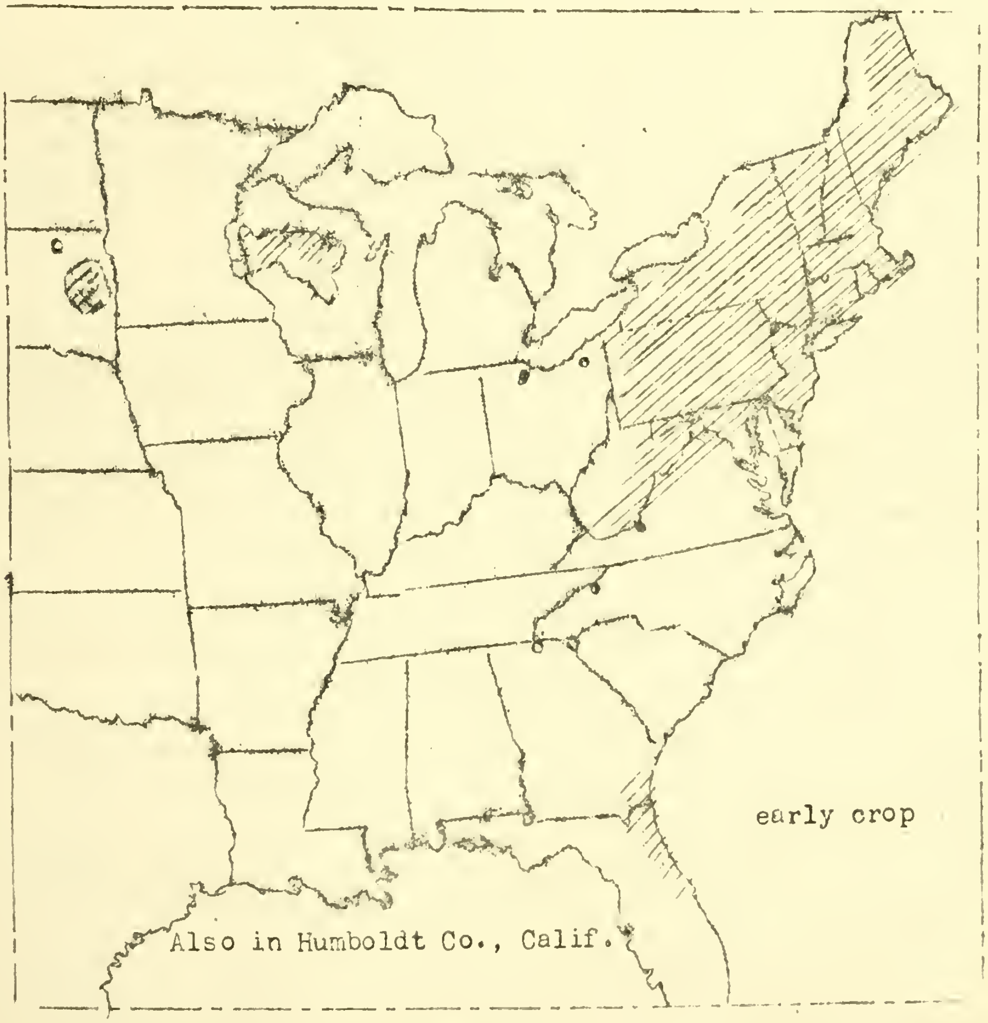

Fig. 30. Range of late blight and rot of potato in 1919 as shown by field records. Shaded area indicates general infection and dots represent spotted occurrences.

As usual the disease was most abundant and destructive in New England, but this year the percentages of disease in Massachusetts, Rhode Island, and Connecticut probably exceeded that in the three states farther north. In Southern New England the disease was the worst it has been in years, and the loss in this section probably averaged about 25%. G. P. Clinton said that it was either the most serious, or next to the most serious, outbreak that Connecticut has experienced for the last eighteen years. Eastern New York, Pennsylvania, Maryland,

Table 54 Amounts of late blight rot in carload shipments as found and reported by inspectors.

Origin of shipment	No. of cars with rot	Average percentage of rot	Range of percentage of rot		Remarks as to seriousness of rot.
			No. of cars	Per cent	
Canada	195	10	173	1-25	
			15	25-50	
			7	50-75	
Florida	3	24	2	2	Occasional potato decayed.
			1	50	Very irregular decay.
Illinois	6	9	4	3-7	Slight decay.
			2	17-20	Decay irregular.
Maine	503	9	451	1-25	
			44	25-50	
			8	50-85	
Maryland	1	5		5	
Massachusetts	14	7		2-35	
Michigan	6	4		1-8	Slight decay in most cases.
Minnesota	32	11	29	1-25	Mostly slight decay.
			2	25-50	
			1	70	Decay varied from 25-100% in different sacks.
New Hampshire	1	9	1	8-10	
New Jersey	60	10	53	1-25	
			4	25-50	
			3	50-60	
New York	82	8	79	1-25	Mostly slight decay.
			2	25-35	
			1	50	
Ohio	1	2		2	Slight decay.
Pennsylvania	8	3		1-7	Slight decay.
Rhode Island	1	10		10	
Virginia	3	2		2	Slight decay.
Wisconsin	67	16	60	1-25	Slight decay.
			7	25-52	
Unknown origin	1	2		2	

Total .... 1000 Total number of cars inspected .... 5959 and West Virginia also suffered heavily. The disease was equally bad in New Jersey and Delaware on the late crop of potatoes, but as the early crop is the principal one the actual loss in these states was not so great as in those where late potatoes are more important.

A table giving percentages and bushels loss is given elsewhere in this bulletin, (Supplement 12, 1920), but for convenience a portion of it is presented here:

Table 55. Percentage loss from late blight in states where one or more per cent damage was incurred in 1919.

State	Per cent loss	State	Per cent loss	State	Per cent loss
Maine	10	New York	8	West Virginia	15
New Hampshire	20	New Jersey	5	North Carolina	1
Vermont	15	Pennsylvania	15	Georgia	2
Massachusetts	25	Delaware	5	Florida	15
Rhode Island	25	Maryland	10	Wisconsin	2
Connecticut	30	Virginia	2		

The disease was found abundantly in shipments of potatoes from the northeast portion of the country and from Canada. Table 54 shows the distribution of cars by states and the amounts of decay.

The loss to the early crop in the northern and central parts of Florida was heavy. The disease started there about the first of March and, favored by wet and cool weather, soon became epidemic. In the Hastings Palatka Section it is estimated that 20% loss was sustained, while for the state as a whole 15% loss is thought reasonable.

The disease apparently was not important in the Lake States except in Northern Wisconsin, where considerable vine and tuber injury took place. The accompanying map shows the region where the disease occurred on the tubers. A map showing the vine injury would be approximately the same. Killing of much of the foliage took place in Barron, Chippewa, Rusk, and Dunn Counties, and one-fourth total killing was evident on the heavier soils of Langlade,

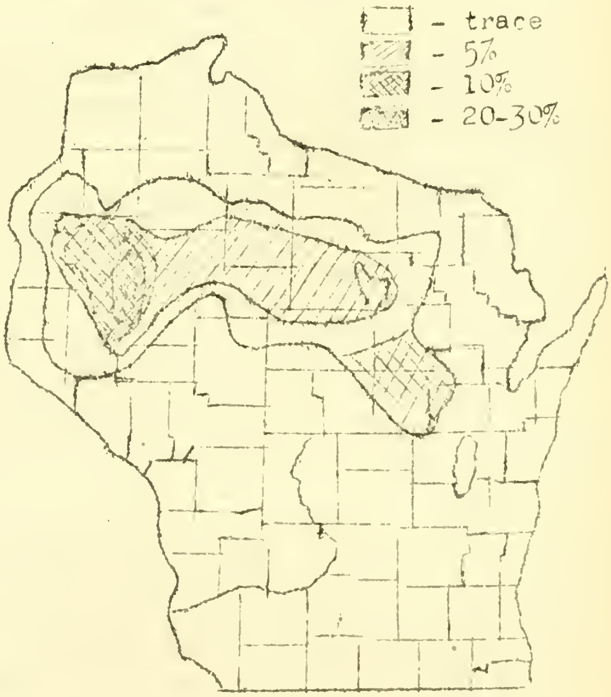

Fig. 31. Geographic distribution of late blight tuber rot in Wisconsin, 1919. After map prepared by W. W. Wright.

Lincoln, Marathon, Price, Taylor, Oneida, Burnette, and Polk Counties. Five to twenty-five per cent was evident on newly dug green potatoes in Barron and Chippewa Counties about September 12. County Agent R. F. Cuff of Barron County estimated that the loss to the farmers of Barron and Chippewa Counties from rotted tubers and loss in handling was at least $300,000. The following points regarding tuber rot were noted by W. H. Wright who followed the situation closely in Wisconsin last year:

(1) The severity of tuber rot was related to the sererity of the foliage injury.

(2) The foci of the infection in 1919 corresponded to the areas where the disease was observed in 1918.

(3) Very severe tuber rot was more or less coincident with the foci of primary infection in 1919.

Regarding the general situation in Wisconsin Wright reported as follows:

> "The development of late blight during the season of 1918 and 1919 indicated that the great potato growing sections of the state are probably never free of the disease, that is, it is epidemic. Such being the case, the danger from an epidemic developing will always be a possibility. Whether or not one occurs will always depend on soil and climatic conditions and on the efficiency of the control measures.
>
> "There cannot help being a large amount of infected seed planted in 1920. With an average season there are almost certain to develop many foci of infection early and spontaneously. In case of favorable weather conditions it is difficult to see how a general epidemic is to be prevented."

The influence of the weather on late blight in 1919 is worthy of note. In Florida, where the disease appeared earlier than usual (March 4), the weather was wet and cool much of the time from then until harvest, with the result that the disease became destructive. In Maine, New Hampshire, Vermont, Massachusetts, Connecticut, New Jersey, Pennsylvania, and Maryland special mention is made of the fact that the disease was checked by the dry weather of late July and early August but became prevalent later in the season with the occurrence of wet weather in late August and September. In Wisconsin excessive rains during August, high humidity, low temperatures, and no killing frosts until October, all tended to accelerate blight and rot.

Table 56 gives the approximate dates when late blight was first seen by collaborators. These constitute all the dates given on report cards filed in the Survey Office. The literature has not been examined for dates of first appearance.

Early potatoes escaped for the most part in the northeastern late blight section. The disease developed too late to be of consequence on that crop. Clinton in Connecticut mentioned that some persons seemed to think that Dibble's Russet rotted less than other varieties and Vaughan in Wisconsin reported Rivals as more resistant than Green Mountains.

Results of spraying were reported as follows:

Florida: "Spraying with Bordeaux successful." (Sherbakoff)

New Jersey: "Bordeaux gave fine results." (Cook and Martin)

Pennsylvania: "Sprayed fields show little or no infection." (C. R. Orton, October 15.)

New Hampshire: "We have found that an 8-4-50 Bordeaux mixture applied every two weeks gave superior protection to a 4-4-50 mixture applied weekly and that Bordeaux mixture in which the ratio copper to lime is 1:1/2 gives better protection than those in which the more usual ratio 1:1 is employed." (Butler)

Vermont: "A number of farmers who did not give a late spray had a high percentage of rot." (Gilbert)

Connecticut: "In this state spraying has not come into general practice, partly because no farmers specialize on growing potatoes and we have no particular potato district. In general, I would say that fields that were sprayed thoroughly this year gave fair returns, but spraying did not cut down over 50% of the loss from the rot." (Clinton)

Table 56. Dates when late blight of potatoes was first noted by collaborators as shown by Survey records.

State	Date when disease was first reported to collaborators.													
	1903	1905	1906	1907	1908	1909	1912	1913	1914	1915	1916	1917	1918	1919
Me.					9-10	8-Lt						7-23	7-E	
N. H.			8-10									7-28	8-24	8--
Vt.		8-13	7-M								9-1	7-9	7-17	10-1
Mass.												7-25	8-8	7-24
Conn.	8-8										7-19	7-24	7-17	8-4
N. Y.		6-25	6-22		9-Lt		8-Lt		7-	6-23	8-2	6-20	7-16	
N. J.		9-5					10-24					7-15	7-15	
Pa.										8-16			7-15	7-17
Md.		8-1										8-1		
Va.							7-21	7-1					7-16	7-1
W. Va.												7-19	8-1	7-25
N. C.												5-		7-15
Ga.													5-25	6-10
Fla.		4-5	5-	4-			4-1					4-2		3-4
Ala.													4-1	
Ohio		7-15	7--	8-9	8-22		8-17			8-9		7-24		10-6
Mich.	8-M						7-							
Wis.		7-12	9-		8-				9-1	8-11	7-28		8-13	7-26
Minn.									9-6	8-5	8-12	7-13	7-17	11-3
Iowa		7-14											8-6	
Wash.							7-	5-30						
Ore.							8-20	9-15		6-Lt				

E = early in month, M = middle of month, Lt = late in month.

West Virginia: "We conducted potato spraying experiments and secured very satisfactory results. The experiments were conducted in a 20 acre commercial field and the increased yield amounted to approximately 50% as a result of spraying." (Giddings)

Early blight caused by Macrosporium solani E. and M.

Early blight was reported from practically all states where potatoes are grown. It was said not to have been found, however, in Washington and Montana, and it was not common in the northern parts of the other northern tier of states such as Minnesota, Michigan, Wisconsin, and Maine. It was common in almost all states and abundant in a number of them including New Jersey, Delaware, Kentucky, Tennessee, Ohio, South Dakota, and Colorado. Certain collaborators mentioned parts of their states where the disease was worst. Thus, in Florida it was especially common in the southern part and a similar condition was mentioned in New Hampshire. In Arizona it was worst in Coconino County, which is the largest potato section, and in Kansas it was epiphytotic in parts of the Kansas River Valley.

Regarding the situation in the Kansas Valley, J. W. Blachly reported as follows:

> "In my last trip to the Kaw Valley district June 17, I discovered that early blight had developed in a number of potato fields. In fact, there have been only a few outbreaks in the history of the Kaw Valley potato industry. The last one was in 1915 and did very little damage. In about 1908 several fields suffered quite severely. The present outbreak is by far the most severe of any. The disease is strictly a wet weather trouble.
>
> "Following is an estimate of damage done in certain parts of the Kaw Valley. This estimate was made by an examination of the maturity of the potatoes.
>
> Lenape, damage 35% over early estimate of yield.
> Loring, damage 35% over estimate 3 weeks ago.
> Edwardsville, Kansas, damage 35%.
> DeSoto, damage 35% from early blight and 15% from blackleg over the estimate three weeks ago.
> Williamstown, damage 20%.
> Perry, damage 25%.
> Topeka, damage 25% over estimate 3 weeks ago.
> Rossville, damage only slight.
>
> "A few of the growers sprayed their late planted potatoes and I believe they are receiving considerable benefit thereby. The Cobblers are not affected very much by blight, in fact, I do not believe there will be over 10% damage on the Cobbler crop. Dry weather is setting in now and I think it will aid the late planted potatoes; a great many of the early planted fields have completely lost their foliage and the rest of them will lose their foliage within the next few days. This seems to be the worst epidemic of early blight that has been in the Valley, in fact only one or two growers have had any experience with it before."

The losses from early blight were moderate on the whole and not so large as in 1918. The estimates of collaborators have been brought together and the percentage losses are given on the accompanying map. The losses in bushels will be given in Supplement 12, 1920.

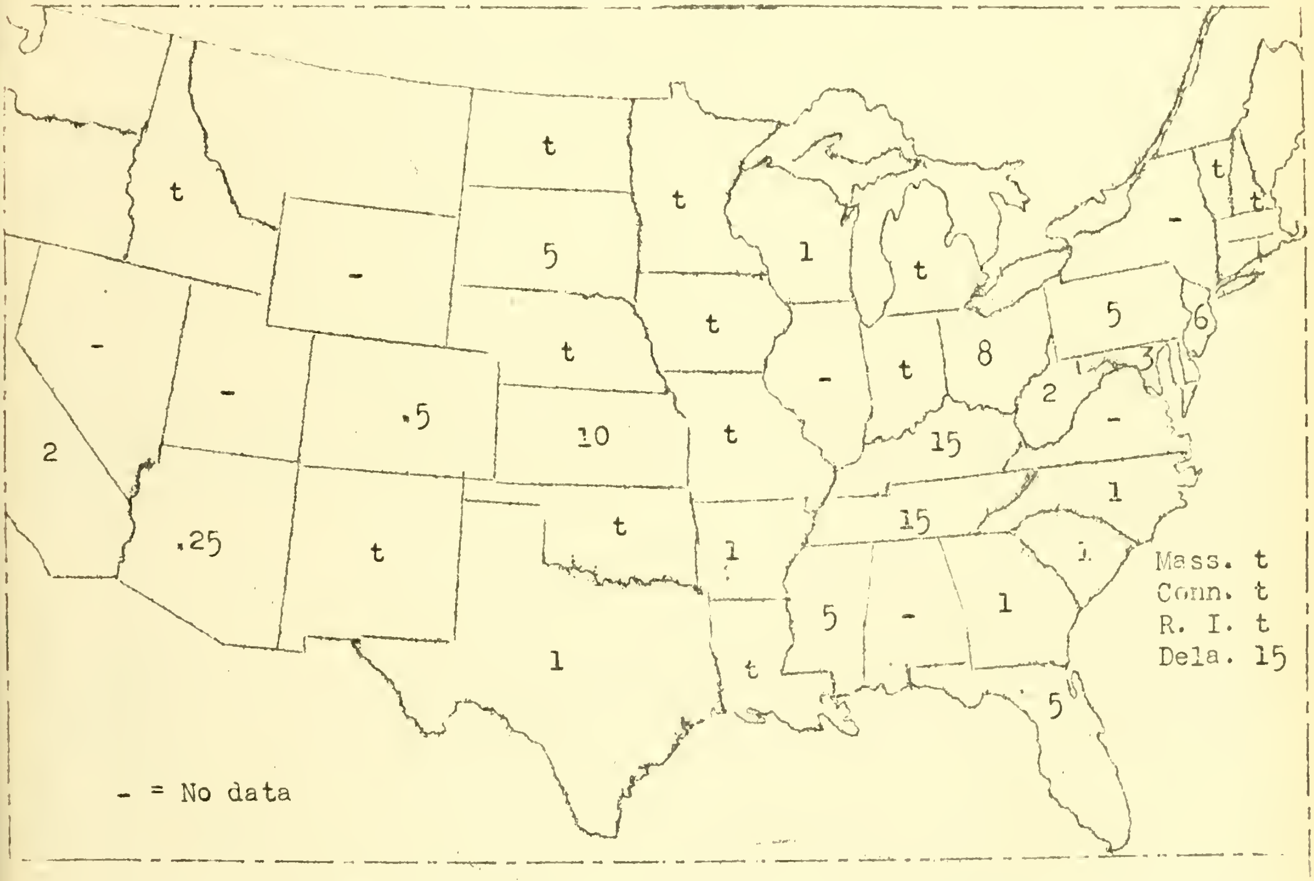

Fig. 32. Percentages reduction in yield of potatoes from early blight, 1919. (See also Pl. Dis. Bul. Supl. 12, 1920).

Dates of earliest recorded appearance in 1919.

March 31 ...... Florida
April 18 ...... Mississippi
May .... Arkansas (on early potatoes)
May 13 .... Tennessee
" 15 .... South Carolina
" 28 .... Georgia
" 28 .... Arkansas
June .... Maryland
" 8 .... Oklahoma

June 14 ...... Indiana
July 16 ...... Minnesota
" 25 ...... Connecticut
" 28 ...... Maine
" 28 ...... Wisconsin
August .... N.Hampshire
" 20 ...... Colorado
September .... Arkansas
(on late potatoes)

The disease was nearly always reported worst on the early varieties such as Irish Cobbler. Late maturing potatoes like those of the Rural and Green Mountain groups as a rule were not badly attacked.

In a number of states difficulty is experienced in controlling this disease with Bordeaux. Thus in Georgia nearly as much injury took place on certain sprayed fields as on those that were unsprayed. In Florida, Bordeaux was not entirely successful. On the other hand Tennessee, and also Wisconsin, reported success with Bordeaux when carefully and thoroughly applied.

Fusarium wilt caused by *Fusarium oxysporium* Schlecht.

This disease occurred to a greater or less extent in practically all states where potatoes are grown with the possible exception of northern New England, but injury was not severe except locally in some of the states occupying a belt through the middle portion of the country. For the United States as a whole the disease was probably about as prevalent as in 1918, but in Colorado, owing to a dry summer, there was considerably less than usual and in Minnesota it was also below normal. On the other hand in some of the states farther west such as California, Nevada, and Idaho, the disease seemed to be fully as destructive if not more so than in the previous year.

Estimates of the reduction in yield from Fusarium wilt have been made by states and the losses in percentages and bushels will be given in Plant Disease Bulletin, Supplement 12, 1920. For convenience the tentative percentage estimates are also given on the accompanying map. These figures are subject to revision.

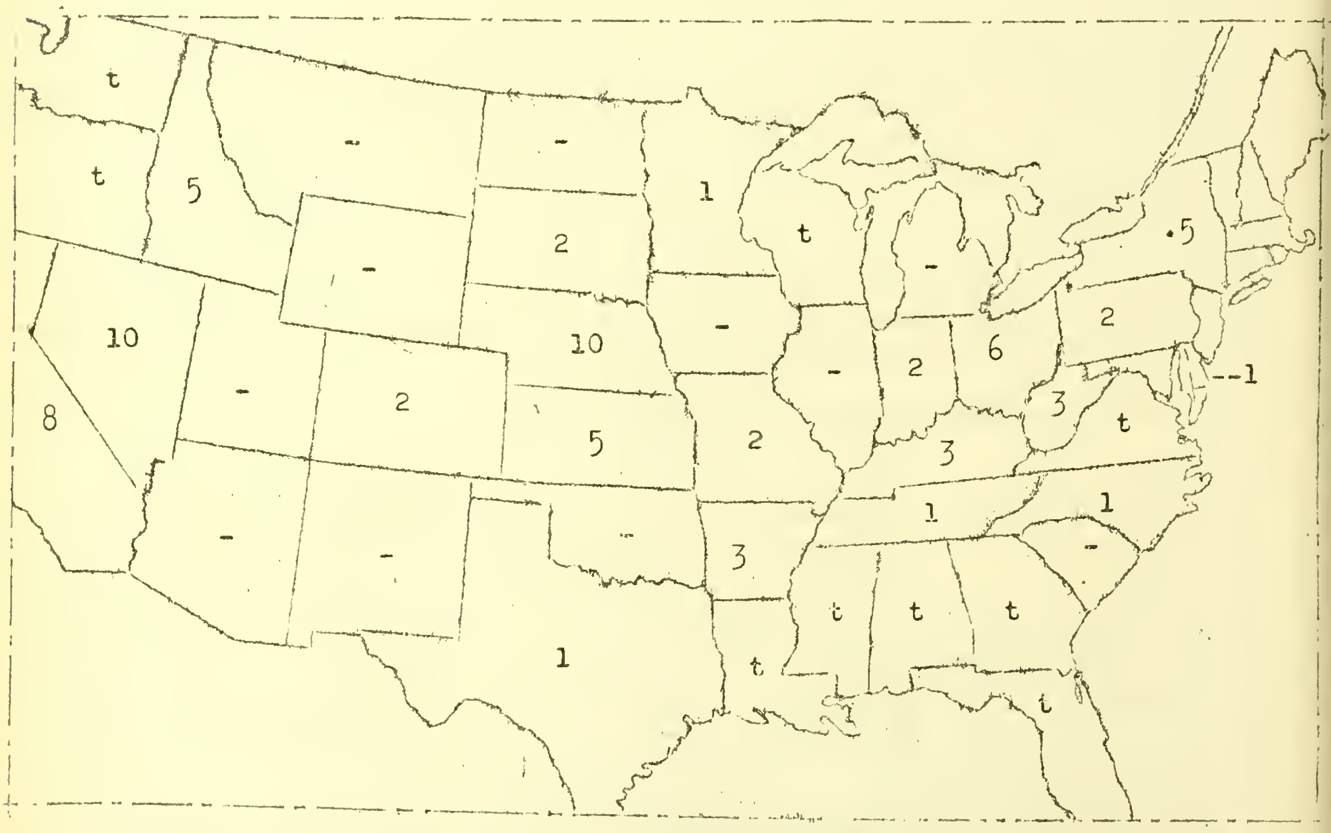

Fig. 33. Percentages reduction in yield of potatoes from Fusarium wilt, 1919. (See also Pl. Dis. Bul. Supl. 12, 1920).

The dates when the disease first began to appear on the vines were given by collaborators as follows:

July	Arkansas	August 8	Ohio
" 12	Colorado	"	Wisconsin
" 18	Indiana	September 23	Minnesota
" 28	Tennessee		

The variety Burbank was reported most susceptible in Nevada.

Practically no headway seems to have been made commercially in the control of Fusarium wilt.

Verticillium wilt caused by *Verticillium albo-atrum* Reinke and Berth.

This wilt disease was reported from Maine, North Dakota, and Oregon. In Northern Maine it was found by M. Shapovalov in at least two large commercial fields, one at Ft. Fairfield and the other at Houlton, where affected plants ranged from 5-15% in different parts of the fields. In Oregon no especial search was reported, but it was said to be present in about the same amounts as usual.

Bacterial wilt caused by *Bacterium solanacearum* E. F. S.

The range of this disease in 1919 was distinctly southern as usual. It was reported from North and South Carolina, Florida, and Arkansas. In no state was it particularly destructive although it was present in about 10% of the fields in North Carolina and caused rather heavy losses locally in Florida.

Stem rot and scurf caused by *Corticium vagum solani* Burt.

This disease was reported in 1919 from all states except Vermont, Rhode Island, Connecticut, West Virginia, Kentucky, Tennessee, Mississippi, Illinois, Wyoming, New Mexico, Utah, and Oregon. It undoubtedly occurred in those states but escaped being reported.

In general it was not so abundant as usual. This falling off in Wisconsin was attributed to too hot weather by R. E. Vaughan, and in Montana it was thought that drought was the reason for the decrease.

The losses which were below normal, occurred chiefly because of missing hills, uneven stands and "little potatoes". The estimated percentage loss by states is indicated on the map in Fig. 34. The losses in bushels will be found in another supplement of this publication (Pl. Dis. Bul. Supl. 12, 1920).

Approximate dates when disease was first noticed on vines according to collaborators:

May 15	South Carolina	July	Arkansas
June 2	Missouri	July 17	Pennsylvania
June 9	Colorado	August 3	New Hampshire
June	Wisconsin	August 15	Indiana

In Iowa the disease was said to be worse on Early Ohio than on Rural

New Yorker, while in Wisconsin the Rural group seemed to be more affected than the Green Mountain.

Disinfection with corrosive sublimate is mentioned in a number of states as being very satisfactory and no unfavorable comments were received. Collaborators were asked to give a rough estimate of the percentage of growers treating potato seed and the following replies were received:

Vermont: "Over 50%."

Virginia: "Very few."

West Virginia: "Probably 20% or more."

Tennessee: "Ten per cent."

South Carolina: "Very few."

Louisiana: "Not more than 10%"

Ohio: "Eighty per cent."

Michigan: "Probably 10%."

Minnesota: "Probably 10 or 20%. Definite figures not available." (Bisby)

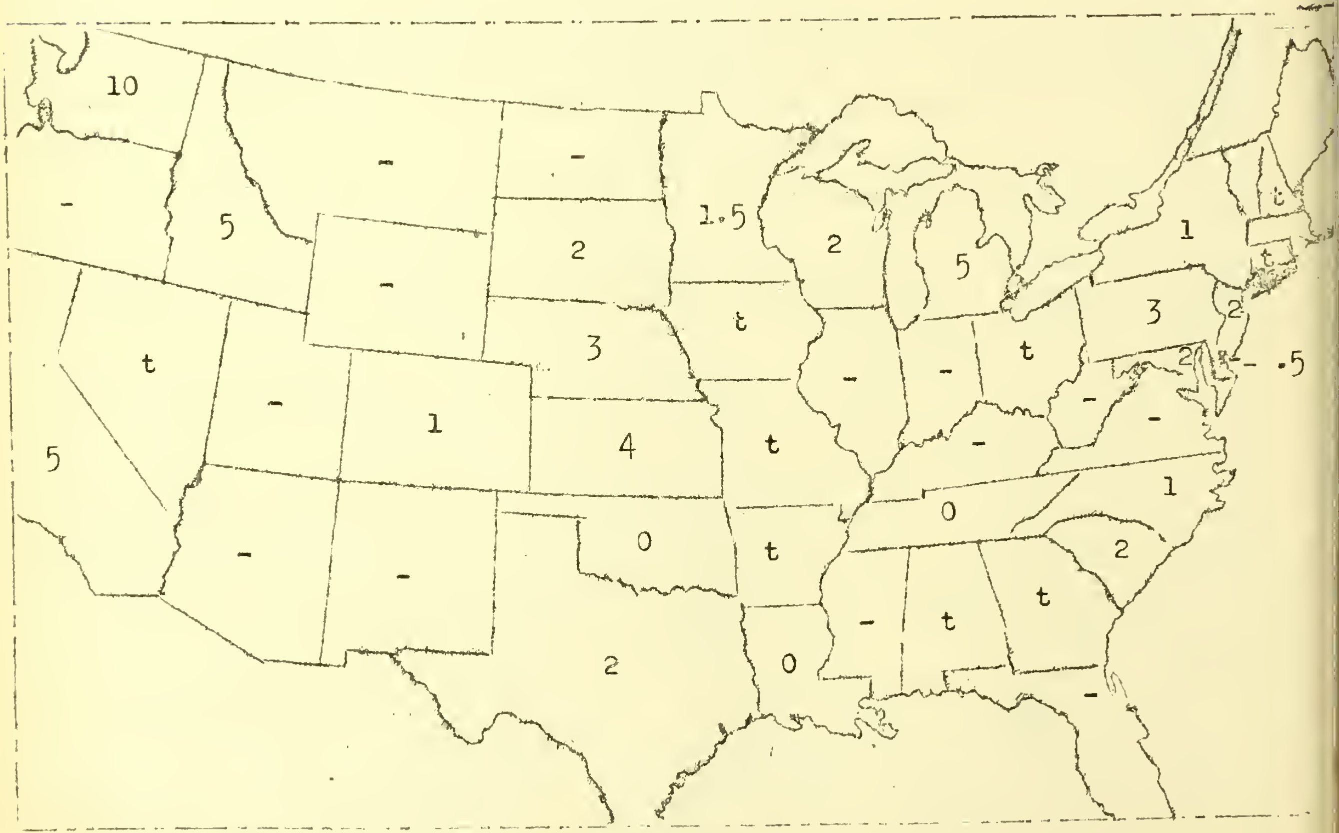

Fig. 34. Estimated percentages loss from Rhizoctonia on potato in 1919.

Missouri: "Likely very few." (Maneval)

Kansas: "About 15% of the potato seed planted is treated." (Melchers)

Colorado: "Probably not more than 10%."

Nevada: "Twenty-five per cent." (Lantz)

Idaho: "About 50% of growers disinfect potatoes, using corrosive sublimate." (Hungerford)

Washington: "General for commercial growers; rare for the home garden."

California: "Quite general." (Smith)

Scab caused by Actinomyces scabies (Thax.) Güssow.

Scab was common as usual. A number of states such as New Jersey, Delaware, Ohio, and Tennessee reported more than last year, while other states like Connecticut, Colorado, and Oklahoma reported considerably less.

It was also said to be especially bad in certain sections of many states. Thus, in the southeastern part of Delaware it did a great deal of damage and in parts of Southern Idaho it was serious.

Estimates of injury as made by collaborators are given in the following table:

Table 57. Percentages of injury and loss to potatoes from scab, 1919.

State	Percentage of injury.	Percentage loss	State	Percentage of injury.	Percentage loss
Vermont	25-50	10-15	Arkansas	5	-
Pennsylvania	10-15	4-5	Wisconsin	-	3
West Virginia	10	2	Iowa	-	15-20
South Carolina	10	1	South Dakota	25	5
Georgia	15	2	Nebraska	-	5
Mississippi	-	5	Nevada	2	-
Louisiana	10	high	Idaho	10	2
Texas	-	5			

Soil temperature has recently been shown to be an important factor in scab development (Jones, L. R. and McKinney, H. H. Phytopath. 10: 63, 1920). It is very probable that geographic distribution and variations in amount of scab from year to year may be explained partially on this basis. Soil type is also a factor to be considered and made the subject of study. McMillan in Colorado reported more scab on sandy land, while Gardner in Indiana noted it as very prevalent on heavy soils.

Early varieties were said to be most affected in Wisconsin and Colorado. The Rural New Yorker in the former state seemed to be the most resistant. In

Minnesota it was said that, "Early Ohio is grown more than any other one variety, and is often very heavily scabbed."

Regarding seed treatment, collaborators were asked to give any results that they may have experienced with warm formaldehyde or warm corrosive sublimate. The replies were as follows:

> Vermont: "Results seem to be satisfactory. Mercuric chloride method good."
>
> Connecticut: "In general, formalin is the treatment given for scab on potatoes, and as yet, so far as I know, no attempts have been made to use it in the warm and stronger form." (Clinton)
>
> Arkansas: "Laboratory test did not show warm formaldehyde to be satisfactory for Rhizoctonia that could be controlled by corrosive sublimate or by soaking in formaldehyde." (Elliott)
>
> Ohio: "No experimental tests, favorable results reported by a few growers." (Selby)
>
> Michigan: "Warm formaldehyde treatment satisfactory in our local plots for scab, not for Rhizoctonia."
>
> Minnesota: "Not yet used by growers. Experiments here did not indicate the necessity for heating formaldehyde and our experience with hot water grain treatment indicates that growers will not take particularly kindly to it." (Bisby)

In Wisconsin corrosive sublimate is considered more satisfactory than formaldehyde, according to R. E. Vaughan.

It is estimated that 5-10% of the farmers in Pennsylvania, and 25% in Nevada, treated their seed last year before planting.

Black leg caused by Bacillus atrosepticus Van Hall.

Black leg occurred widely in 1919, it being reported from Maine, Vermont, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, North Carolina, Georgia, Ohio, Indiana, Michigan, Wisconsin, Minnesota, Iowa, Arkansas, North Dakota, South Dakota, Nebraska, Kansas, Montana, Colorado, Arizona, Idaho, Washington, and Oregon.

A number of states such as Connecticut, Wisconsin, Minnesota, Nebraska, and Washington reported less than usual. This was attributed to the dry summer in Nebraska.

The losses in the main potato sections were not heavy, as a rule, although in Kansas, Arkansas, Nebraska, and Idaho estimated losses of 10, 4, 2, and 3% respectively were sustained. L. E. Melchers found this to be the most serious tuber borne disease in Kansas and J. W. Blachly reported the following regarding the outbreak in the same state:

> "The past week I inspected about 25 potato fields and ten market garden tracts in the Kaw Valley. In the potato fields I found from 5% to 25% black-leg. In one of the treated fields at Edwardsville, Kansas,

treated stock on probably 20 acres showed only a trace of black-leg, while untreated fields showed 5%, and seed from another lot showed 10%.

"At Muncie, Kansas, I found a field which had about 18% black-leg injury and also was showing about 30% loss from Rhizoctonia. This section has had excessive rainfall and the growers are a little discouraged. At Turner, Kansas, a few miles from Muncie, I found from 5 to 10% black-leg, and at De Soto, Kansas, I found an average of 5%.

"At Topeka I went over the whole section. Mr. Kelsey's 110 acres of treated stock showed a trace of injury from black-leg. A field of 60 acres of untreated seed showed from 5 to 10% injury from black-leg. The average yield from this district, however, should be close to 250 bushels, and in some fields it will average 300 bushels."

In Aroostock County, Maine, only traces were found except in one large field where about 5% occurred.

Judging from the reports the disease was most abundant last year in the West. Collaborators in Montana and Colorado say it was particularly bad in the western part of their states. In Oregon as high as 25% was reported in individual fields. Estimates of losses by states will be found in Plant Disease Bulletin 12, 1920.

The earliest dates of recorded appearance were:

May 20	Washington	June	Wisconsin
June 1	Georgia	July 5	Minnesota
" 1	Maryland	" 8	Colorado
" 12	Iowa	August	Ohio
" 17	Indiana		

Seed treatment with corrosive sublimate is mentioned as giving good results in Wisconsin, Kansas, and Idaho. The evidence collected by Blachly in Kansas is given above. Melchers in the same state says,-

> "In untreated seed the amount varied from 1-35%. Seed treated with corrosive sublimate gave almost perfect control."

C. W. Hungerford in Idaho gave the following illustration bearing on the subject:

> "A striking instance of the value of seed treatment for black-leg was shown at Idaho Falls. A grower treated with $HgCl_2$ but ran out of solution and planted a few rows with no treatment. Where treated, less that 1% of black-leg and where not treated 35% of the plants were dead or dying June 27."

Wart caused by Chrysophlyctis endobiotica Schilb.

The discovery of potato wart in Pennsylvania in 1918 immediately gave rise to the question, How widely has this new disease become established in the United States? Before practical control measures could be effectively and wisely applied a knowledge of the approximate distribution of the disease was absolutely essential. It was, therefore, arranged that the Plant Disease Survey, in cooperation with the state experiment stations, state departments of agriculture and the Federal Horticultural Board, should conduct a country-wide search for wart in 1919.

The survey was organized and started in the southern states in June when early potatoes were being dug, and was continued in the northern states until potato harvesting was over. In Minnesota, Nebraska, Kansas, Oklahoma, Texas, and all states east, a survey man was assigned to each state to work under the direction of the state collaborator. In Pennsylvania, West Virginia, Ohio, and New York, where the search was most concentrated, a group of men worked in each state; while in the states west of the 100th meridian no actual surveying was done but the state collaborators gave the matter considerable publicity.

The survey for the newly introduced disease had two phases; the publicity campaign and the garden inspection.

The publicity campaign. Illustrated printed matter in the form of circulars and post cards was provided and somewhat over a million of the latter were distributed during the season. As many as possible of the officials, individuals, and agencies that could aid in the search for wart, were personally visited and their assistance secured. Among those who became interested, and who actively cooperated, may be mentioned experiment station workers, the extension service, including county agents and home demonstration agents, state departments of agriculture, college professors, school teachers, school children, garden clubs, etc., postmasters, newspapers, potato dealers, potato associations, boy scout organizations, gardeners, and farmers, etc. Much effort was put into this work which was fully justified by the results, for of the eight new discoveries of wart, four resulted from this educational campaign.

Garden inspection. In localities where wart was strongly suspected to occur considerable garden search was made. This phase of the work was conducted particularly in Pennsylvania and neighboring states, especially after new occurrences of wart began to be found.

In Pennsylvania the cooperative work was divided between the State

Table 58. Summary of potato wart survey by Pennsylvania State Department of Agriculture in the western coal area of Pennsylvania, 1919.

County	Number of towns and villages.	Total number of gardens in these	Gardens with potatoes visited.	Gardens with wart	Acres	Bushels
Allegheny	24	1,224	209	0	22[illegible]	669.25
Armstrong	7	831	758	0	14	293
Beaver	1	1,500		0		
Butler	5	450	285	0	5.5	21.75
Fayette	35	7,090	36	0	73	2,895
Greene	13	1,077		0	3.25	794.25
Indiana	2	53	11	0	5	108
Lawrence	3	3,425		0		34.5
Somerset	1					1,200
Washington	34	3,375	474	0	77	988
Westmoreland	52	8,389	799	0	317.75	2,900.25
Total	177	27,914	2,572		504.5	10,084

Department of Agriculture and the Agricultural Experiment Station. The State Department, under the direction of W. A. McCubbin, surveyed the country surrounding the infested area in Eastern Pennsylvania and also made an intensive survey in certain counties in the western part of the state as shown in Table 58.

The Pennsylvania State Agricultural Experiment Station, cooperating with the Plant Disease Survey, intensively surveyed certain towns and villages in the west-central part of the state. The scope of their operations is shown in the following table:

Table 59. Extent of intensive wart survey work in West-central Pennsylvania, 1919.

County	Number of towns and villages	Number of gardens	*Number of gardens inspected	Acres inspected
Cambria	30	2,760	1,152	207
Center	3	410	290	44
Clearfield	23	1,485	914	146.5
Bedford	1	50	9	2
Huntingdon	2	70	48	5
Indiana	4	190	65	9
Jefferson	9	405	205	33
Somerset	14	537	286	39.2
Westmoreland	3	120	71	13
Total	89	6,027	3,040	498.7

In West Virginia garden inspection and publicity work were conducted in what were considered to be the most important places. The following table shows the number of towns visited by counties.

Table 60. Number of towns visited in potato wart survey in West Virginia, 1919.

County	Number of towns	County	Number of towns	County	Number of towns
Barbour	3	McDowell	4	Preston	15
Berkeley	2	Mason	2	Raleigh	3
Brocke	3	Mercer	5	Randolph	7
Cabell	1	Mineral	2	Summers	1
Fayette	6	Mingo	5	Taylor	1
Grant	4	Monongalia	2	Tucker	16
Jackson	1	Morgan	2	Wayne	3
Kanawha	2	Ohio	1	Wood	1
Logan	1	Pocahontas	3		

---

*This is approximately the total number of gardens where potatoes were grown.

Results. As a result of the nation-wide survey in 1919 wart was discovered in six villages in Western Pennsylvania and in two in Northern West Virginia. The accompanying table shows the important data regarding the new findings.

Table 61. New locations of potato wart infestations in Western Pennsylvania and Northern West Virginia, as determined by the potato wart survey, 1919.

State	County	Town	Date wart was found	Number gardens infested	Finder
Pennsylvania	Cambria	Nanty Glo	Aug. 27	2	L. E. Yocum
		Lilly	Sept. 13	1	H. S. Stahl
		Vintondale	Sept. 27	2	C. L. Farabaugh
		Llanfair	Sept. 23	10	A. J. Garretson
	Clearfield	Osceola Mills	Oct. 8	5	C. L. Farabaugh and party.
	Center	Clarence	Oct. 15	2	C. L. Farabaugh and R. L. Mankey
West Virgina	Randolph	Whitmer	Sept. 9	1	E. Angelo and H. C. Daniels
	Tucker	Thomas	Sept. 12	11	E. Angelo

All six villages where wart was found in Pennsylvania are mining settlements in the bituminous section of the state and are inhabited largely by foreigners. Thomas, West Virginia, is also a soft coal mining village, while Whitmer is a small saw-mill settlement and is the only point of infestation found outside the mining area. The complete findings regarding the occurrence of wart are illustrated on the accompanying map.

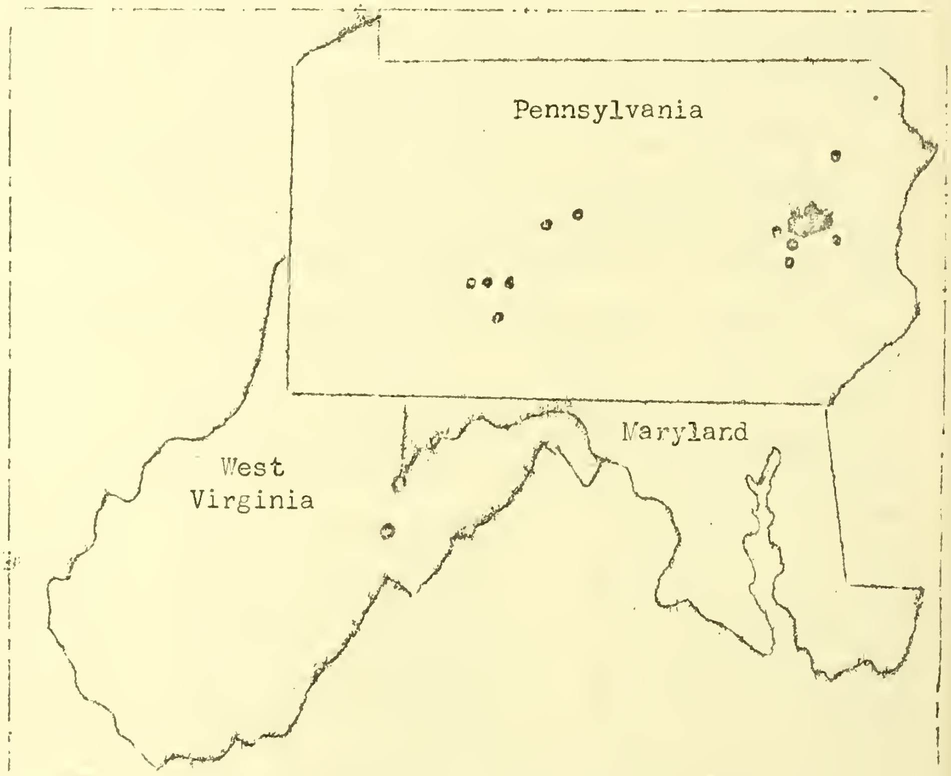

Fig. 35. Outline map showing present known geographic distribution of potato wart. Each dot signifies a village where the disease has been found. The augular area in Eastern Pennsylvania represents the original Hazleton-Freeland quarantined district.

During the summer field men of the Pennsylvania State Department of Agriculture, who intensively surveyed the country surrounding the original Freeland District, further delimited that area and found some outlying infestations. The accompanying map showing the distribution of the disease in this part of the state has been supplied by W. A. McCubbin of the Pennsylvania State Department of Agriculture.

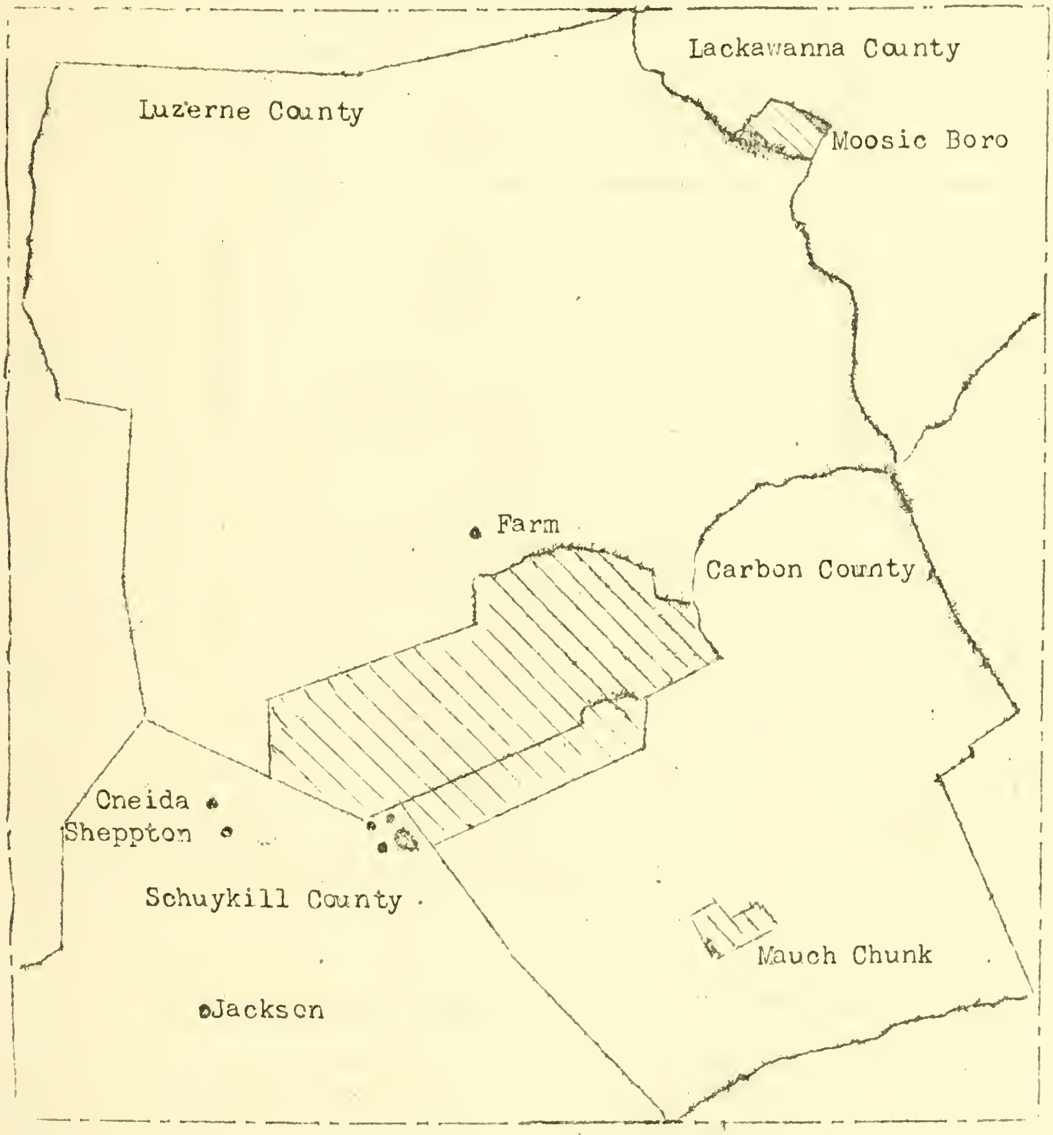

Fig. 36. Areas in Eastern Pennsylvania where potato wart has been found and which are quarantined on account of the disease.

It is rather significant that all of the occurrences of wart found thus far have been in or near coal mining villages. It is also significant that all of the eight new locations discovered in 1919 are small and in no way comparable to the extensive Eastern Pennsylvania District, which, after the survey of the past season, can probably be said with certainty to be the largest wart infested area in the United States. Small areas, however, might easily have escaped discovery so that further search should be made, and a vigilant watch maintained for other appearances of the disease.

Fusarium tuber rot caused by *Fusarium* spp.

Both the dry and wet types of Fusarium rot were common in shipments of potatoes in 1919. Out of the 5959 cars of potatoes inspected 1069 showed Fusarium tuber rots in varying amounts.

Table 62. Percentages of Fusarium tuber rot in cars of potatoes as determined by market inspectors, 1919.

Origin of shipment	Number of cars with decay	Average percentage of decay	Origin of shipment	Number of cars with decay	Average percentage of decay
Arkansas	1	20	Missouri	13	7
California	27	5	Montana	18	4
Canada	67	7	Nebraska	15	9
Colorado	92	9	New Jersey	49	8
Florida	8	4	New York	28	4
Idaho	51	8	North Carolina	16	14
Illinois	43	13	North Dakota	24	6
Indiana	2	7	Ohio	6	5
Iowa	2	2	Oklahoma	7	4
Kansas	10	7	Oregon	14	8
Kentucky	4	44	Pennsylvania	11	3
Louisiana	4	38	South Dakota	4	8
Maine	77	3	Texas	17	8
Maryland	7	18	Utah	8	7
Massachusetts	10	10	Virginia	13	19
Michigan	98	4	Washington	23	5
Minnesota	209	5	Wisconsin	75	6
Mississippi	1	10	Wyoming	5	15
			Unknown	10	11
			Total	1069	

Total number of cars inspected 5959

Jelly end rot caused by *Fusarium radicicola* Wr.

This rot injured as high as 25% of the tubers in some fields of Southern Idaho and is thought to have caused a loss of about 1% of the crop of that state. It was also reported from Washington.

Potatoes with jelly ends, thought by inspectors to be due to *F. radicicola*, were also found on the market from California (4 cars), Idaho (11 cars), Illinois (3 cars), Minnesota (1 car), New Jersey (3 cars), Oklahoma (1 car), and Washington (1 car). The decay in all these shipments ranged from 1 to 13% and averaged 6.2%.

Powdery dry rot caused by *Fusarium trichothecioides* Wr.

Powdery dry rot probably destroyed 10% of Nebraska's potato crop in storage during the winter of 1918-1919. What was thought to be this rot was reported by market inspectors in shipments of potatoes from Michigan (1 car 4%), Wisconsin (2 cars 8 and 12%), and Minnesota (1 car 10%).

Root knot caused by Heterodera radicicola (Greef.) Müll.

Nematode injury to potato tubers was reported from Delaware (one case), Virginia, Georgia, Florida, Alabama, Arkansas, Texas, and Nevada. Most of these states received an unusually large number of specimens of this trouble last year on account of the publicity given to potato wart. Many growers suspected the swellings caused by nematodes as being wart.

Tip burn (non-parasitic) and hopper burn induced by leaf hoppers.

Tip burn occurred widely in 1919. Along the Atlantic Coast in the eastern part of the country it was not so prevalent as during the previous season. In California, it was also said to be less than usual. In the North Central states, however, the condition was serious. Thus Indiana reported it the most important potato trouble, injuring 70% of the crop and causing a loss of at least 3% of the crop. In Michigan tip and hopper burn was exceedingly common everywhere, cutting the yield of potatoes on the Upper Peninsula almost in two

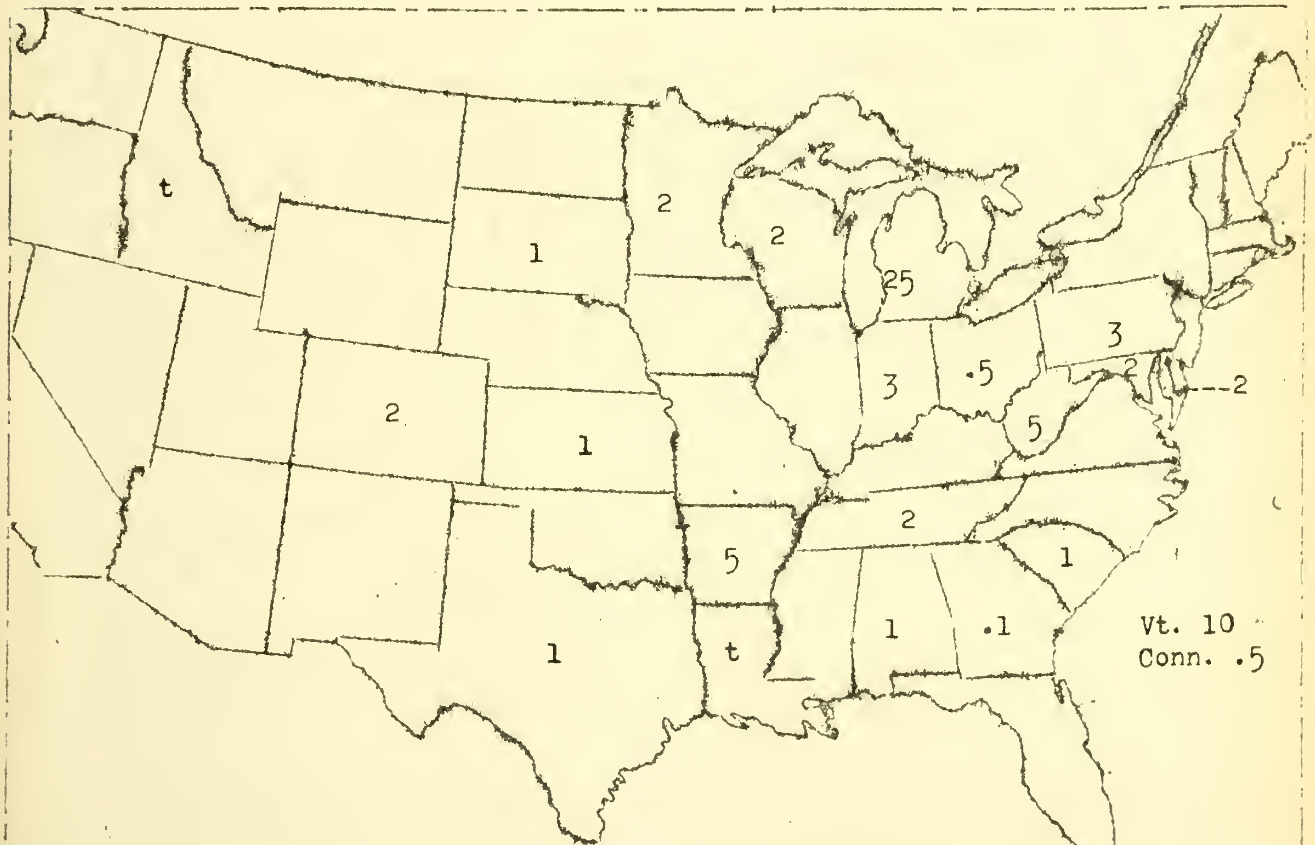

Fig. 37. Percentage losses from potato tip burn, 1919.

and causing the state's early crop to turn out a failure. In Iowa, Southern Wisconsin, and parts of Missouri, Kansas, and Colorado the injury was serious.

Estimates of losses from tip burn have been made and a table showing percentages and bushels reduction in yield will be found in Plant Disease Bulletin Supplement 12, 1920. The map in Fig. 37 shows the distribution of losses.

As usual the early varieties suffered most. Early Ohio in Missouri and Iowa, and Bliss Triumph in Pennsylvania, Wisconsin, and Iowa were mentioned as being badly injured.

When applied early and thoroughly, Bordeaux mixture was helpful in reducing the amount of tip burn in Indiana and Wisconsin.

Mosaic (cause undetermined).

Mosaic was reported from practically all states in 1919. In some states, especially those in which susceptible varieties are not common, the disease was of very little importance, but in others, where potatoes like Triumph, Green Mountain and American Giant are the principal commercial varieties, the losses were considerable.

The accompanying map shows the distribution of losses by states.

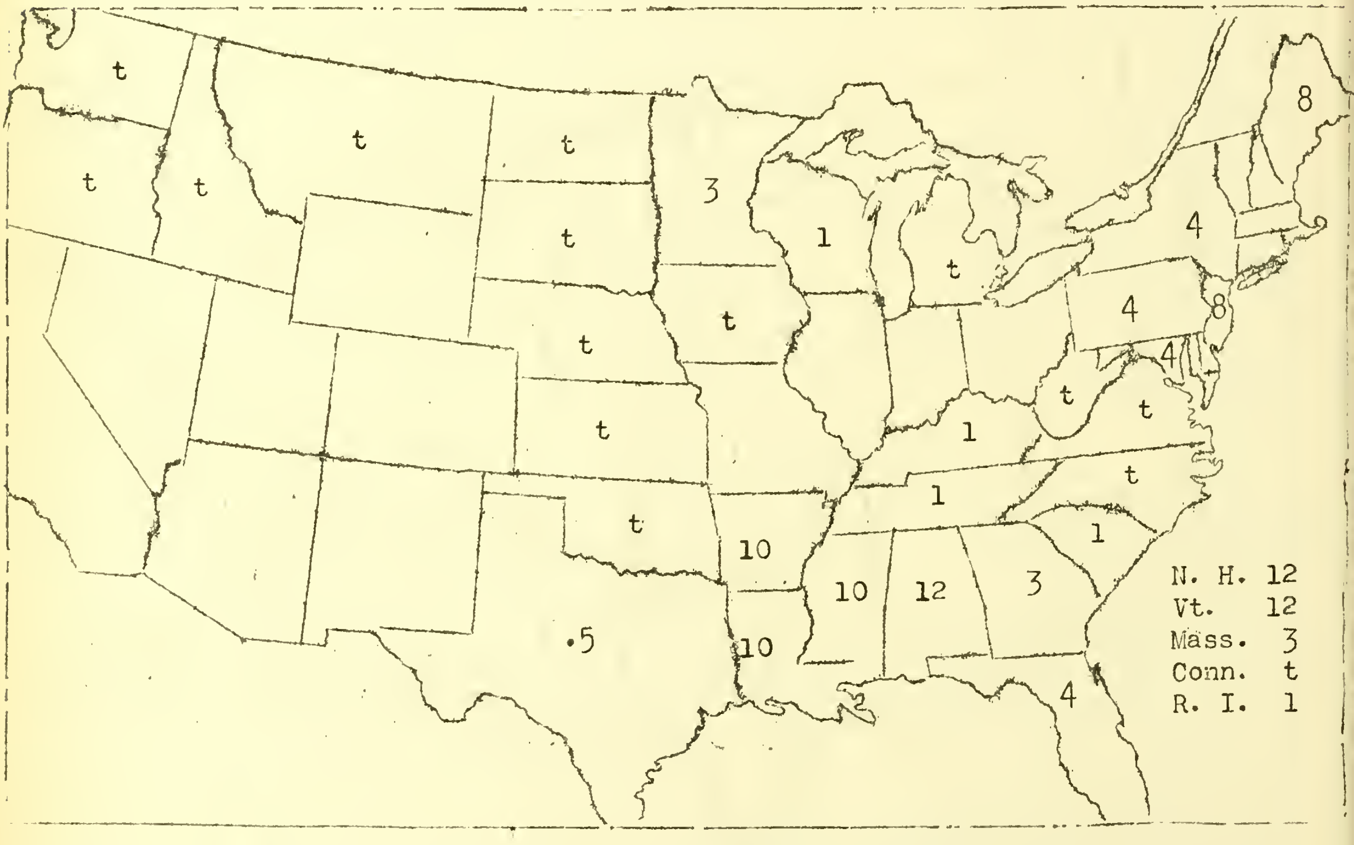

Fig. 38. Estimated percentages loss from mosaic, 1919.

In New England and also inparts of the South the disease was said to be less conspicuous and less destructive than usual. In Louisiana there was not so much of the dwarf stage as is commonly seen.

The following data on varietal susceptibility have been received:

Alabama: "Especially on Triumph. Cobblers not so bad." (Hopkins)
"Wherever Triumph is grown a very high percent (25-95) of plants badly affected." (Hesler)

Arkansas: "Irish Cobbler resistant. Ten per cent of Bliss late crop affected." (Elliott)

Colorado: "Seems to be increasing on Triumphs." (McMillan)

Georgia: "Developed on more than 90% of Bliss Triumph regardless of source of seed." (McClintock)

Idaho: "Netted Gem only variety seriously affected." (Hungerford)

Iowa: "Common only on Bliss Triumph which is not grown commonly. None found on Rural New Yorker." (Melhus)

Louisiana: "Nearly 100% of Bliss Triumph affected. Scattering on other varieties." (Edgerton)

Maine: "About the usual amount of mosaic, mainly on Green Mountains and Bliss Triumph." (Shaplovalov, Aug. 8.)

Maryland: "Causing 10% loss in most late crop fields, especially on the McCormick." (Temple)

Michigan: "Common, especially in Upper Peninsula on Green Mountain and Bliss Triumph. None seen on Rurals." (Coons)

Minnesota: "Particularly on Triumph. Rare on other varieties." (Section of Plant Path.)

Mississippi: "Mosaic on Bliss Triumph in every part of state visited." (Hesler)

New Jersey: "Very abundant on American Giant. Sometimes 50% infection." (Cook).

New York: "Found in all of white sprout area and also where White Giants are grown." (Chupp)

Oregon: "Considerable in one field of California White Rose." (Barss)

Pennsylvania: "In trial plots at State College Blue Victor, McCormick, Manistee, and Extra Early Crusader showed 100% infection; Early Russett and Early Rose 95-90% infection; Norcross 15%; Peachblow 5%." (C. R. Orton)

South Carolina: "Cobblers are planted chiefly but a few reds are found and they have from 20-100% mosaic." (Seal)

Leaf roll (cause undetermined)

Leaf roll was reported to the Survey in 1919 from Maine (found scattered here and there on Irish Cobblers and even less on Green Mountains; absent or slight in many fields), Vermont (scattering, possibly 5-10% loss), Massachusetts (present in a large percentage of fields; most severe as a rule on native stock), Connecticut (inconspicuous this year), New York (common everywhere, especially where "blue sprouts" are grown), New Jersey (less than usual, not found to exceed 2% in any case), Pennsylvania (generally found throughout state averaging at least 10-25% affected plants), Maryland (prevalent), Tennessee (common, slight loss), Louisiana (loss small in most commercial fields but high in some such patches), Texas, Oklahoma, Michigan (occasional, losses slight as a rule), Wisconsin (trace), Minnesota (trace), South Dakota, Montana (frequent), Arizona (negligible in Yavapai County), Idaho (slight), and California (found in all parts of state, 8% reduction).

The disease was mentioned as occurring severely on Dibble's Russet in Connecticut, New Jersey, and Pennsylvania, and on Irish Cobbler in New Jersey. At State College, Pennsylvania, the following varieties, arranged in order of susceptibility, were found to be attacked: Seneca Beauty, Early Six Weeks, World's Wonder, Dibble's Russet, Gold Coin, Petoskey, and Rural New Yorker.

Curly dwarf (cause undetermined)

So-called curly dwarf was reported from Indiana, Iowa (severe in Early Ohio), Nebraska (slight), and Idaho (rare).

Malnutrition

Breaking down of potato plants, known as "malnutrition trouble" or "potash hunger" was noted by Shapovalov in Maine in some of the earlier planted fields where a fertilizer containing no potash was used. It was also observed by Clinton in Connecticut but there was much less than usual in that state. Local occurrences were also reported in South Carolina and Minnesota.

Anthracnose caused by Colletotrichum sp.

This apparently new disease was discovered August 1 in a garden near Vermillion, Ohio, by collaborator A. D. Selby. A few days later it was found at Wooster apparently doing considerable damage and by the end of the season it had been reported from twelve Ohio counties, most of which were located in the northern part of the state. It seemed to be most common on the early crop but abundant and widespread. Very often the fungus was associated with early blight or Fusarium wilt so that the strength of its parasitism is still open to question. Miss Freda Detmers is working on the disease.

Internal brown spot (cause undetermined).

This disease was reported from Washington and California and a similar if not the same trouble was observed by many pathologists on Long Island, New York, at the time of the Potato Conference June 24-28.

In California D. J. Milbrath reported the trouble to be very general in all sections, affecting a large percentage of the crop. Burbank was more affected than White Rose, Harvest King, or British Queen.

Borax injury caused by borax in fertilizers.

This trouble has been the subject of study and report by Schreiner, Brown, Skinner, and Shapovalov of the Bureau of Plant Industry (U. S. D. A. Department Circular 84, 1920). In Maine the injury was largely confined to Aroostook County, where a great deal of the fertilizer associated with this trouble was used. In other places, however, where injurious fertilizers were applied, the injury appeared to be about the same as in northern Maine. For full report on this subject see publication mentioned above.

Other diseases.

Southern blight caused by Sclerotium rolfsii Sacc. was reported from South Carolina and Louisiana. About 1% injury was reported from the latter state.

Powdery scab caused by Spongospora subterranea (Wallr.) Johnson was reported from Minnesota by J. J. Christensen, field assistant on potato wart survey, as follows:

> "Powdery scab was found at Two Harbors, in Lake County and at Virginia and Duluth in St. Louis County. The infections at Virginia and Two Harbors were quite light but the one at Duluth appeared to be quite severe."

According to the Section of Plant Pathology at St. Paul this is the first report of its occurrence in the state since 1916.

Violet root rot caused by Rhizoctonia crocorum (Pers.) D.C. was reported from Sheridan and Kimball Counties, Nebraska. This was said to be the first occurrence of the disease on potato in Nebraska.

Spindling sprout (non-parasitic) reported from New Hampshire, Pennsylvania, and New Jersey.

Soil rot (pox or pit) caused by Cyptospora batata Elliott occurred on white potatoes in New Jersey. The total injury to the crop was reported to be less than 1%.

Leak, probably caused by Pythium or Rhizopus, or both, was reported by D. G. Milbrath to be present, as usual, in California in the Stockton Delta region.

Stem and tuber rot caused by Armillaria mellea was said to be common in newly stumped land in Michigan, and was also reported from Klickitat County, Washington.

Dodder (Cuscuta arvensis Beyrich) was reported injuring potatoes in Walla Walla County, Washington.

Streak, cause not known, was reported from Pennsylvania (Center County; injury 5-10% in one garden; August 25); from Minnesota (one report, Itasca County); and from Idaho (quite common in southern part of state; reported from Canyon, Elmore, and Twin Falls Counties; loss estimated at .5%). In Pennsylvania the disease was observed only on the Green Mountain variety grown from Vermont seed.

Dwarfing of plants, similar to curly dwarf but with no curling of the leaves, was said to have been observed in several fields in southern Idaho, (Elmore County), The loss ranged from slight to 25% in the fields affected. The disease was apparently carried with the seed as all the fields in which it occurred were planted from the same seed lot.

Chlorosis (non-parasitic) was said to be common in southern Idaho.

Sun scald (non-parasitic) was reported from Yakima County, Washington and from Idaho where it was very severe in the Boise and Payette Valleys, causing a loss to the mid-season crop of Idaho Rurals estimated at more than 5%. In the latter state it was said to have been caused by leaving potatoes planted in light soil in the ground without irrigation when no cars could be secured.

Lightning injury was reported from Pennsylvania, Louisiana, Minnesota, and Wisconsin. In Pennsylvania, C. R. Orton reported one spot, including 125 plants killed in Erie County, August 20. In Louisiana, C. W. Edgerton reported the killing of all plants in an area 30 feet in diameter. In Minnesota, one case of a spot 15 feet in diameter was observed and in Wisconsin three instances of slight injury were noted, and reported by R. E. Vaughan.

Spray injury was reported from Connecticut, New Jersey, and Pennsylvania.

DISEASES OF TOMATO

Leaf spot caused by Septoria lycopersici Speg.

Leaf spot occurred in the greatest amounts again as usual in the group of states comprised of New Jersey, Delaware, Maryland, Virginia, West Virginia, Ohio, Indiana, Illinois, Kentucky, and Tennessee. There are indications also that parts of the Carolinas lost heavily.

It was common but not serious in most of the southern states except Florida and Louisiana where only a few occurrences were noted. In fact the report from Florida is the first received from that state since a single collection by Harter in 1910. Last year it appeared in one field at Moore Haven doing considerable damage to young plants on April 1. The occurrence of the disease in this state should be watched from year to year, in order to determine its behavior under Florida conditions.

The disease was not a factor in the Lake states, but in Iowa, Missouri, Nebraska, Kansas, Oklahoma, and Texas some loss was sustained although nothing like that in the Central Eastern group. Slight amounts of the disease are reported from Colorado, where it was noted for the first time last year, but was apparently not of any importance. In fact, the Survey has no record of its occurrence in many of these western or Pacific states, nor does it have any data to show that this leaf spot has ever been at all destructive in those regions

This may possibly be because it is limited by natural factors, or as is perhaps more likely the case, the organism may not be sufficiently abundant to cause much damage. The fact that it was first noted in Colorado in 1918 and in Florida last year for the first time in recent years is significant. It may indicate that the disease is spreading. A glance through some of the older survey records shows reports in 1907 when leaf spot was just beginning to show up in Marion County, Illinois. Only one report of the occurrence of the disease in Washington (1913) is at hand; none from Oregon; and only two from California (1912-1917). It would seem that the disease would bear watching on the Pacific Coast.

In the region already mentioned; namely, the tri-state section, made up of New Jersey, Delaware, Maryland; and the Ohio Valley states, Septoria leaf spot is by far the most important of all tomato diseases, causing an average loss last year of about 20% of the crop.

The tri-state area, which is the most intensive and the most important tomato canning section in the country, and Virginia and West Virginia produced about two and one-half million cases of No. 3 canned tomatoes in 1919. It is estimated that this same area sustained a loss of about 24% of the crop from tomato leaf spot alone or about 1,000,000 cases off from the normal production. The following table shows losses incurred by leaf spot in the important commercial tomato canning state-groups.

Table 63. Losses caused by Septoria leaf spot of tomato in the important commercial tomato canning state-groups.

State	Commercial production canned tomatoes (cases #3)	Percent	Reduction from normal. (cases #3.)
New York Pennsylvania	514,140	3	18,472
Delaware Maryland New Jersey Virginia West Virginia	2,641,897	24	1,006,435
Ohio Indiana Illinois Michigan Minnesota Iowa	1,045,491	5.5	64,427
Colorado Washington Utah	995,119	.2	2,293
California	1,736,207	t	-
Missouri	504,534	2	11,088

Dates of first appearance according to collaborators, 1919.

April 1	Florida (young plants)
April 18	Mississippi (in seed bed)
May	Louisiana
May	Arkansas
May 15	South Carolina
May 20	Tennessee
May 29	Indiana
June 8	Missouri
June 10	Georgia
June 20	South Dakota
June 25	Minnesota
July 2	Virginia
July 2	Oklahoma
July	Wisconsin
August 2	Ohio

The only mention of varietal resistance was made by Fromme in Virginia and Elliott in Arkansas. In their states the variety Norton was said to be somewhat less susceptible than other varieties.

In no state does spraying for the control of tomato leaf spot appear to be practiced commercially to any great extent, although plenty of demonstrations have been made in a number of states where leaf spot is bad to show that on the average it greatly increases the yield. In many cases this is probably because the growers are waiting to be shown that it actually pays them to spray, and then again the exact spraying program has still to be laid before them. In Louisiana, Edgerton reported that spraying is not satisfactory. On the other hand, in Oklahoma, Bordeaux gave good control in some cases, and in North Carolina Jehle reported a great reduction of leaf spot on the plots in Avery and Mitchell Counties that he was spraying for late blight.

Fusarium wilt caused by *Fusarium lycopersici* Sacc.

Fusarium wilt is distinctly southern in its range. It caused its greatest damage in the South Atlantic and Gulf regions and in adjacent states. Further north the disease becomes less frequent, although it is of much importance in the tri-state tomato region composed of New Jersey, Delaware, and Maryland; in the Ohio Valley; and south of the Missouri River. The disease extends northward up the coast as far as Connecticut, where it occasionally occurs to a slight extent, but in the northern tiers of states the disease is practically absent in the field although occasionally destructive in greenhouses. In Florida it has been observed for several years but has not been rated as of great importance. Last spring, however, it was found by Pritchard and Clark to be serious, at least in the southern part of Dade County where they found some fields with from 75-90% infection. They made an estimate of 40-50% infected plants for the Miami and Homestead sections. It is probable, therefore, that the losses from this disease in Florida have been under-estimated in the past. In the western states its occurrence is somewhat a matter of uncertainty on account of its confusion with diseases of a similar nature such as the yellow blight of the northwest and the summer blight of California. However, a report has been received from Milbrath in California, indicating that Fusarium wilt does occur in that state and probably causes as high as 3% loss. It is also mentioned as occurring in the southern part of Colorado and in East Central Arizona, but the exact identity of the disease in these states does not seem to have been established.

This disease is the most important tomato disease of the extreme South Atlantic and Gulf states. It ranks second only to Septoria leaf spot in importance for the United States as a whole. Estimates of losses would seem to indicate that in general it was more severe in 1919 than in 1918 in spite of the fact that considerable progress was made toward control in some sections. In the Southern States tomato production would undoubtedly become much more important if it were not for this persistant soil trouble. As it is now, Florida is the only state that produces many early tomatoes for the northern markets.

Loss estimates by state and for the country as a whole have been made and are given in Plant Disease Bulletin, Supplement 12, 1920.

The dates when the disease was first noted in 1919 in various states are as follows:

March 24	Florida (just appearing in field)
March 24	Louisiana (in seed bed)
April 20	Mississippi (one young plant)
May	Louisiana (general in field)
May 15	Georgia
May 15	Tennessee
May	Arkansas
June 15	South Carolina
June 17	Indiana
July 2	Oklahoma
July 15	Missouri

Varietal resistance to this disease is rather marked and because of the fact that many states have been trying out resistant strains the following specific question was asked collaborators in connection with the request for their annual report: "What was your experience with the use of tomato seed resistant to Fusarium wilt? Give varieties used, source, and success with each." Most collaborators who had made observations along these lines kindly complied with the request and their statements are given below by states as follows:

Virginia: "Norton has been used for two seasons and has proved wilt resistant and also of good quality and a heavy bearer. Marvel, Arlington, and Columbia were also distributed this year but little information has been received on their performance." Fromme.

West Virginia: "Tomato seed resistant to wilt has been used in several locations and has given good results in several cases, but not in others." Giddings.

Tennessee: "The common variety of tomatoes known as 'Livingston's Globe' is naturally resistant to Fusarium wilt, and it is used extensively in the Humboldt section. A resistant strain selected by the Tennessee Station has been tried out on a small scale. This seed can be secured from the Botanist of the Station for trial." Essary.

North Carolina: "The Marvel, Arlington, Norton, and Columbia varieties of tomatoes were obtained from the U. S. Department of Agriculture and tested in many parts of the state. In only one place a definite report was received, at Lexington, North Carolina, and here they gave entire satisfaction, all other tomatoes dying from wilt." Jehle.

South Carolina: "Small plots with good results. Varieties used were Arlington, Marvel, Norton, and another variety, all from Mr. F. J. Pritchard."

Louisiana: "Two wilt resistant varieties of tomatoes developed at the Louisiana Station and the four government varieties tested alongside of commercial varieties. The two Louisiana varieties Norton and Marvel show more resistance than the others. None of them are really wilt resistant, but some of them show more tolerance. Of all varieties tested, the Stone is the most susceptible and produces the poorest yield of any. The use of this variety has hurt the work of the girls' tomato and canning clubs in many sections." Edgerton.

Florida: "Certain varieties of the globe type seem to be much more resistant than others." Sherbakoff.

Arkansas: "Norton, Columbia, Arlington, and Marvel secured from Washington, have been tried out on a large scale and several other varieties secured from Manns of Delaware Station on a smaller scale. One variety originated by Dr. Manns proved the most resistant under all conditions tried in a two years' test. Next to this came Norton, which was about 50% resistant in a field test where Columbia, Arlington, and Marvel were not over 15% resistant and where nonresistant varieties were a complete failure. In this test Dr. Manns' tomato was about 80% resistant. Seed of the Norton tomato was sent to a great many places over the state and reports of success when other varieties failed were received from most of them." Elliott.

Missouri: "The seeds of varieties of tomatoes resistant to Fusarium wilt put out by the United States Department of Agriculture are said to be more or less promising." Maneval.

Kansas: "The past season some of the tomato varieties resistant to Fusarium wilt have been given a rather careful test. Results show that they are very promising from the wilt resistant standpoint. In fields where the disease was so abundant that it killed commercial varieties, Columbia and the unnamed variety, according to collaborators in the state, came through without a missing plant in badly infected soil. We are going to give all the varieties a thorough test the coming year. To date they look most promising." Melchers.

Georgia: "All so-called resistant strains which we were able to obtain were tested in badly infested soils in 1919 and none proved sufficiently resistant to grow and bear throughout the summer." McClintock.

Kentucky: "A strain of New Century obtained from Durst in Illinois proved resistant when grown alongside some of the more common varieties at Henderson." Valleau.

Maryland: "Wilt is easily controlled with resistant varieties. Over 2000 persons were furnished with wilt resistant seed this year." Temple.

Ohio: "Only early maturing varieties especially susceptible." Thomas.

Early blight and nail-head spot caused by *Macrosporium* spp.

In the past we have considered early blight and nail-head spot as being caused by the same organism, *Macrosporium solani*. Because of the recent work of Rosenbaum and others, however, it appears that there is more than one organism concerned in these troubles. Hence, they are mentioned above as being caused by *Macrosporium* spp. They are considered together, however, as the reports do not distinguish between the various types of disease.

Nail-head spot occurs chiefly in the extreme southern states. It is far more prevalent in Florida than in any other state but reports are at hand also from Louisiana and Texas, and it is known to occur in the tri-state territory and in the District of Columbia, but is not of commercial importance. The market inspection records further indicate its occurrence in parts of California, Arizona, and Mississippi. In connection with nail-head spot there is also considerable foliage injury.

Injury to the leaves alone with no spotting of the fruit was reported from many of the states in the central-eastern part of the country as far west as Kansas. The state that reported the most trouble from this type of injury was West Virginia where 10% loss was said to have taken place. According to Giddings the disease in that state is usually subordinate to Septoria leaf spot but last year the two appeared to be of about equal importance.

Others of the states such as Massachusetts, New Jersey, Nebraska, and California report the most injury to ripe or nearly ripe fruit, attacking especially through growth cracks, sun scald spots, or other injuries.

In Delaware Rosenbaum found Macrosporium to be taking part in the collar rot trouble that was so prevalent in the state last season. In Indiana and Kansas the disease was mentioned as causing considerable trouble in greenhouses. In the former state it was epidemic in one greenhouse near Indianapolis, and also appered in the seed beds and fields causing leaf spotting and stem cankers.

Table 64. Percentage nail-head spot as shown by inspection at destination by inspectors of the Bureau of Markets, 1919.

Origin of shipment	No. of cars with nail-head spot	Average percentage of nail-head spot	Range of percentage of nail-head spot	Remarks as to seriousness of injury.
Arizona	1	6	5-8	Affected fruit showed 1-2 spots.
California	2	16	7-25	One car showed 25% fruits with 1-3 spots.
Florida	116	12	1 car 90	2-10 spots.
			9 cars 30-50	Generally 3-6 spots.
			106 cars 1-25	All stages.
Louisiana	1	90	90	5-15 spots on each tomato and spots badly run together.
Mexico	7	8	2-12	Rather badly spotted.
Mississippi	2	12	1-3	Slight spotting.
Texas	5	5	3-10	Rather badly spotted.
Unknown	2	-	-	More or less decay.

The sum total of loss from nail-head spot in Florida was great as usual. The number, size, and quality of fruit was reduced; many fruits had to be discarded at the packing houses and the tomatoes that arrived on the market were badly blemished. The above table shows the amount of nail-head spot in car shipments as found by inspectors of the Bureau of Markets. The inspections were all made between the dates of February 10 and June 18.

It will be noticed that the disease was especially common in shipments from Florida, as it was found in 116 cars. In one car, inspected June 9 at Chicago, 90% of the fruit showed from 2-10 nail-heads. The average percentage of infected fruits was 12% in the 116 cars and the average number of spots per tomato ranged from 3-6, but with some cars as many as 5-10 spots were noted.

The following table gives the markets and number of cars of Florida tomatoes with nail-head spot inspected at each city:

Table 65. Number of cars of Florida tomatoes with nail-head spot inspected at various cities, 1919.

Place where inspected	Number of cars	Place where inspected	Number of cars	Place where inspected	Number of cars
Baltimore	18	Pittsburgh	9	St. Louis	5
Chicago	18	Boston	7	New Orleans	5
Cleveland	16	Detroit	7	Buffalo	4
New York	10	Philadelphia	6	Others	11

The losses due to Macrosporium on the foliage were heavy in some states, particularly in Florida, Louisiana, Texas, and West Virginia. Figures showing the estimates of loss from this fungus are given in Plant Disease Bulletin, Supplement 12, 1920.

Dates of first appearance, 1919.

February	Florida	May 20	Tennessee
April	Louisiana	June 19	Virginia
May 12	Indiana (greenhouse)	July 28	Ohio
May 15	South Carolina	July	Wisconsin

Certain varieties in Florida are said to be less susceptible than others to early blight and nail-head spot. This is the only state mentioning any variation in susceptibility.

Spraying with Bordeaux was reported on as follows: Florida, fairly successful; Louisiana, only fair results on account of too much rain; North Carolina, usually checked by spraying; South Carolina, fair results.

Mosaic, cause undetermined.

This disease was reported from seventeen states widely scattered over the country. Within most of the states also the disease seemed to be more or less sporadic or localized. Thus, in Florida the disease was said to be especially serious about Ft. Myers and Moore Haven and in Indiana it was especially bad in the canning area. In New Jersey, Maryland, and Louisiana, however, the disease was said to be quite general. It occurred in greenhouses as well as in the field. In one large greenhouse in Ohio a severe outbreak was reported on some 4000 plants of Bonney Best.

Mosaic seems to be increasing in importance. In many localities it caused heavy losses last year. In California it was prevalent in Santa Clara County, which is one of the largest canning production centers of the state. In Florida it appeared to be localized but in sections where it was observed it was very bad indeed. According to Link and Ankeney the growers in those localities claim it has been ruining their crop during recent years. In Georgia 1-2% loss for the state was estimated. In Indiana 50% of the crop was reported injured and the disease was epidemic in the canning section of the central part of the state. In Louisiana a high percentage of the crop was reported injured. In Missouri one field of Dwarf Champion was observed by Philpott in Jasper County, where the disease was severe, and the reduction in yield from this was put at about 30%. In Pennsylvania a two acre field at East Springfield was observed by Muncie which showed at least 90% mosaic plants.

In contrast with these reports of considerable damage, the important tomato states of New Jersey, Delaware, Maryland, and Ohio report that although the disease is common it is not a very important factor in reducing the yield. Collaborators in Minnesota, Nebraska, and Arkansas also speak of it as causing only slight damage.

No varieties were mentioned as showing resistance, and no control measures were given in the various reports received.

Late blight caused by Phytophthora infestans (Mont.) De Bary.

According to the Survey records late blight of tomato is limited to the northeastern portion of the country and to the Pacific Coast. However, reports of its occurrence were received from Kansas in 1918, and from Missouri in 1919. It was noted in seven places, mostly in the greenhouse, in the latter state. As these reports have not been checked yet by specimens they cannot be considered as authentic. The disease was reported also by Stevenson from Porto Rico in 1917 where conditions during the winter months were said to be favorable for its development. No particular damage was done, however.

The accompanying maps show the range of the disease as it has been reported to the Plant Disease Survey during the last five years.

It will be noted that in the East the disease is reported most frequently along the Appalachian Range from Pennsylvania as far

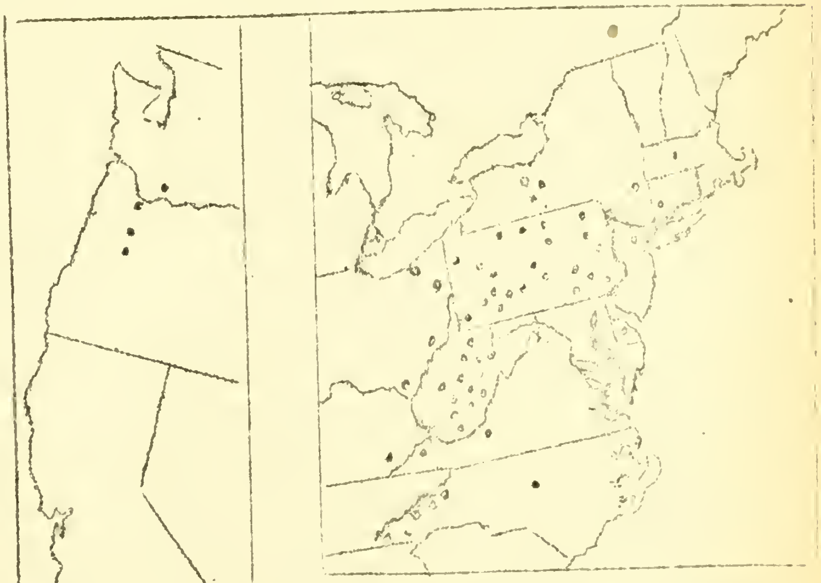

Fig. 39 Composite map showing geographical distribution of late blight of tomato as indicated by Plant Disease Survey reports from 1914 to 1919 inclusive. Each dot represents a county.

south of the Georgia border. The eastern portions of West Virginia and the western extremes of Virginia and North Carolina are in the center of the area where the greatest damage occurs.

In the West the disease has frequently been reported from the northern portion of the Willamette Valley and across the border in Klickitat County, Washington. It will also be recalled that R. E. Smith (Tomato Diseases in California, California Experiment Station, Bulletin 175: 1-16, 1906) reported the disease as causing an epidemic in November and December of 1905 on the winter tomato crop of southern California, particularly about La Habra in Orange County. Doubtless the disease has been present in this section annually since 1905 but no records are at hand to certify as to this. In 1919 no reports of the disease were received from the Pacific Coast States although it probably occurred there.

A study of the reasons for the limited range of this Phytophthora on tomatoes would seem to be a fruitful field for investigation. The preference of the fungus for the higher altitudes in the east, coupled with the fact that in Southern California and Porto Rico it is only active during the winter, would lead to the supposition that temperature is a very important factor. Of course, an abundance of atmospheric moisture is needed and the stage of the crop also has to be taken into consideration.

The total loss from this disease is not great as the damage occurs only in portions of a few states. West Virginia was most affected with about 20% of the crop more or less injured and 8% loss. In that state the season was very moist, with the result that the blight was unusually prevalent. According to Giddings many gardens in the southern and central part of the state matured absolutely no tomatoes on account of the trouble. In Virginia the disease was apparently more or less localized in the vicinity of Blacksburg. Regarding it Fromme says, "Very severe at Blacksburg, causing vine death in some cases and almost complete loss of early settings of fruit during a period of excessive rainfall. With the return of dry weather in August the disease largely disappeared and some fruit matured."

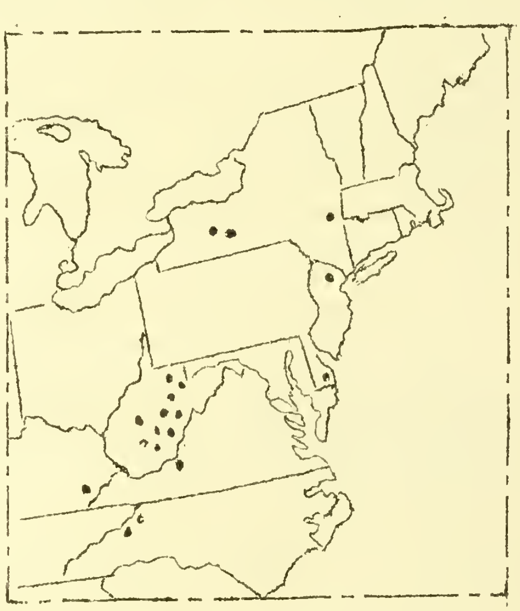

Fig. 40. Geographical distribution of late blight of tomato in 1919 according to maps prepared by collaborators. Each dot represents occurrence within a single county.

In North Carolina the disease was under close observation by Jehle in Avery and Mitchell Counties, where he had demonstration plots to show control by spraying. The checks in these plots and other unsprayed fields in the locality were all more or less severely affected. Even when the vines were only slightly diseased practically all the fruit on them rotted as a result of Phytophthora infection. Jehle estimated a state loss of 2% from late blight. In the other states from which the disease was reported it did not appear to be of particular importance, as the injury was local and for the most part slight.

Table 56. Approximate dates of first appearance of late blight as given by collaborators, 1916-1919.

State	1916	1917	1918	1919
New York	--	September 24	--	--
Pennsylvania	--	October	--	--
Virginia	August 1	--	July 16	July 1
West Virginia	--	Early August	July 28	--
North Carolina	--	--	--	July 15
Kentucky	--	--	--	July 7
Missouri	--	--	--	July 11

Further light is thrown on the relation of Phytophthora on the two hosts, tomato and potato, by the observation reported from New York by Chupp in 1919; namely, that in Cayuga and Tompkins Counties the disease was observed as a fruit rot on tomatoes growing adjacent to blighted potatoes.

Spraying with Bordeaux 5-5-50 plus 3 lbs. of resin fish-oil soap was reported as giving good results in West Virginia and North Carolina. In the latter state Jehle reported that the difference between the sprayed and unsprayed plots in his demonstrations was very marked. He used both the plain Bordeaux and the resin fish-oil soap Bordeaux.

Yellow blight caused by Fusarium spp.

Yellow blight was reported from Washington, Oregon, Idaho, California, Nevada, and New Mexico. The trouble in Washington is referred to by Heald as being due to Rhizoctonia but in the other states collaborators speak of it as being caused by the Fusarium oxysporum and F. orthoceras combination as worked out by Humphrey.

This disease is the most serious tomato trouble of the northwest. Annually it caused much damage and in 1919 the loss appears to have been considerably above the average. In Washington it was said to be more severe than for a number of seasons. Cases were reported by Heald where tomatoes following potatoes showed 95% injury. In Oregon at least 25% loss was sustained in the principal tomato section. In Idaho it was very common and destructive throughout the state, killing as high as 75% of the plants in some commercial fields. In Nevada, where the disease was severe in Chruchill, Washoe, and Lyon Counties, 10% loss was estimated; and in New Mexico 25-100% loss was reported.

Two interesting reports of the yellow blight situation, as it was last year, have been received from Idaho and Oregon. C. W. Hungerford has furnished the following:

"Observations on tomato yellow blight in Idaho in 1919."

"Tomato blight has been reported from every section of the state and seems to have been unusually severe this year. Commercial growers in the Lewiston district in Northern Idaho and those in the Twin Falls district of Southern Idaho unite in saying that the disease has been as destructive this year as it has ever been. A loss of 50% of the entire tomato crop of the state is a conservative estimate.

"Weather conditions seemed to be very favorable to the disease. The season was exceedingly hot and dry. In nearly all of the irrigated districts there was a shortage of water during at least part of the growing season.

"Letters of inquiry began coming in about July 15 and the disease was noted at Moscow about that time. Fields of tomatoes were inspected at Lewiston, Idaho, on July 29 when the first tomatoes were just beginning to ripen. In some of these fields 75% of the plants had already been killed by the blight at that time. These same fields were again inspected September 10 and in some of them 90% of the plants were dead. Many plants which appeared perfectly healthy at the first inspection were dead by the second. It has been noted that plants in the field may die of the disease any time from when they are about eight inches high until frost kills them. In the greenhouse the disease may take seedlings as they emerge from the ground.

"The disease has been noted on new sage brush land which had never been cropped before and on nearly every kind of soil. It was noted in plants which had never been transplanted, the seed having been planted in the ground out of doors in the spring. In many cases it was noted that tomatoes grown on very rich soil and well cared for were injured by blight much less than those on poor soil and those having poor care.

"Some of the varieties of tomatoes grown on the College Farm seemed to be quite resistant to the disease."

From Oregon the following note by M. B. McKay has been received:

"Very prevalent in The Dalles section, the important tomato region of the state, blighting about 50% of the plants and causing not less than 25% loss. Plants that are blighted late produce a part of a crop. All varieties are affected. The four varieties of tomatoes, Arlington, Columbia, Marvel, and Norton, sent out by the U. S. Department of Agriculture as resistant to wilt in the East, are all apparently about equally and extensively susceptible to the Western Yellow Blight. Tomatoes planted on land which had never before grown tomatoes blighted badly. This infection, of course, may or may not have come from the seed bed. One patch from which an excellent crop of tomatoes was being harvested was observed on land which was said to have grown tomatoes consecutively for 25 years. Ordinary commercial seed was being used. Tomatoes in another piece of land not more than 100 yards distant were blighting badly."

Bacterial wilt caused by Bacterium solanacearum E.F.S.

This distinctly southern disease, as usual, occurred most frequently in the Atlantic States south of North Carolina and those bordering on the Gulf. It was said to be common in Arkansas and of infrequent occurrence in Delaware, Maryland, Virginia, West Virginia, Kentucky, Tennessee, Missouri, and Texas; and it was even reported as far north as Pennsylvania, Ohio, Nebraska, and Colorado. These latter states represent the approximate northern limits of the wilt although it has been reported up the Atlantic coast as far north as Massachusetts.

Bacterial wilt cannot be considered of great economic importance when compared with diseases like Septoria leaf spot or Fusarium wilt. For the country as a whole it is a minor disease, but for the tomato industry of the southern states it is a serious trouble. It probably ranks next to Fusarium wilt in importance in that part of the country. Judging from the loss estimates at hand Louisiana probably suffered the most of any state, as 10% loss is estimated, while the other South Atlantic and Gulf states averaged about 5%.

The dates when the disease was first reported are as follows:

May 1	Florida	June	Arkansas
May 15	South Carolina	August 1	Tennessee
June	Louisiana		

No varieties were mentioned as showing any resistance and little was given on control except that crop rotation was mentioned as beneficial by some collaborators.

Blossom-end rot (non-parasitic)

Blossom-end rot was reported from most states with the exception of those in the Rocky Mountain section and part of the Great Plains area.

It can be said quite safely that in general it was less abundant than in 1918, when it was unusually severe. States in the northern part of the country, especially Vermont, New York, and Wisconsin reported it as less troublesome than usual. It was mentioned by Gardner in Indiana and Milbrath in California as worst on the first fruit and that later settings were fairly free. In the early tomato section of San Diego County and the San Joaquin Valley. California, the disease was particularly destructive. The Southern States seemed to suffer most heavily as is shown by the following table:

Table 67. Injury and losses from blossom-end rot as reported by collaborators in 1919.

State	Percent fruit injury	Percent loss	State	Percent fruit injury	Percent loss
Vermont	1-5	1-5	Arkansas	5	-
South Carolina	10	1	Tennessee	10	-
Georgia	5-100	30	Wisconsin	t	t
Florida	-	5	California	-	10
Mississippi	-	20-30	Indiana	5	2
Texas	-	3			

In New York, in the Chautauqua and Niagara districts, some fields showed from 5 to 20% injury and one field was found with 65% of the fruit affected. In Mississippi W. S. Fields found the following condition:

> "At Crystal Springs and Hazelhurst the crop suffered heavily this season through blossom-end rot and cat face. At least 40% of the fruit on the vines is affected with either or both of these. One of the farmers told me that he would be willing to give $1000 to find a way to stop blossom-end rot."

As this disease is clearly evident in the field it is not especially common in shipments of tomatoes. Market inspectors found it in some consignments, however. One car from Florida showed 2% in early stages; two cars from Mexico averaged 8%; and one car from Mississippi had 9%.

The dates of earliest recorded appearance were as follows:

May	Florida	June 14	Washington
May 10	Tennessee	June 18	Indiana
May 15	Mississippi	July	Oklahoma
June 1	Georgia	July	Wisconsin
June 1	South Carolina	August 20	Vermont

No resistant varieties or control measures were mentioned.

Buckeye rot caused by Phytophthora terrestria Sherb.

This rot was found in Florida and Porto Rico during 1919 and two new and interesting occurrences were reported during the year, one by M. W. Gardner, Indiana, where it was found in a greenhouse near Indianapolis; and the other by J. L. Weimer, who observed the disease occurring naturally on plants growing in the department experimental field plots at Arlington Farms, Virginia. The disease was also reported in shipments of tomatoes from Mexico and Tennessee. Since these latter are new records, however, and as they have not been substantiated by findings in the field, they should be considered only as possible rather than actual occurrences.

Judging from the reports at hand the disease was worse than usual in Southern Florida, probably because of the heavy rains that occurred just prior to harvest. The crop was greatly damaged by the flood itself and, in addition, the water greatly facilitated the dissemination of the organism. Regarding the occurrences and losses from the disease in the Miami section Rosenbaum says:

> "All fields are showing an exceptionally heavy infection with ground rot, Phytophthora terrestria. One of the fields where we did some work before the rains and which had very little or no Phytophthora is now showing by actual count more than 66% infected fruit. One grower who had hired special labor for picking fruit on the day following rain, and immediately packed more than 500 crates, was compelled to repack all these on account of the development of Phytophthora rot. Less than one-third of these crates were saved. * * * Shipping work last season proved that Phytophthora spread with great rapidity in transit, a single fruit in a basket likely to involve a large number of fruit in the same basket before reaching market. Market men will likely meet a lot of this trouble in the shipments."

The disease was found in 10 carloads of Florida tomatoes inspected in northern markets in amounts averaging 7% affected fruit.

Staking plants in the field and holding fruit for a few days before packing were beneficial according to C. D. Sherbakoff in Florida.

Phoma rot caused by Phoma destructiva Plowr.

This disease was reported during 1919 as occurring in the field in

Florida, California, Oklahoma, Ohio, and New York. Reports of its occurrence in shipments of tomatoes said to have originated in the additional states of New Jersey, Tennessee, Mississippi, Louisiana, Arizona, were received from market inspectors, and consignments from Mexico, Cuba and the Bahama Islands were badly affected. In other years this disease has been reported to the Survey from the following additional states: Delaware, Maryland, South Carolina, Porto Rico, Iowa, and Kansas. It will be seen then that the disease has a rather wide range although destructive occurrences seem to be confined to the South, especially Florida and to places like Cuba, Bahama Islands, and Mexico.

In 1919 Florida and California were most affected. The occurrences in other and more northern states were localized for the most part in gardens and caused little loss.

The accompanying table gives the amounts of Phoma rot found in shipments of tomatoes by market inspectors. It will be noted that it was quite frequent in cars from Florida and California.

Table 68. Percentages of fruit affected with Phoma, as shown by inspection at destination by inspectors of the Bureau of Markets, 1919.

Origin of shipments	No. of cars with rot	Average percentage of rot	Range of percentage of Phoma rot		Remarks as to seriousness of decay.
			No. cars	Percent	
Arizona	1	18	1	10-25	Scattered throughout load.
California	42	27	3	35-40	Bad decay.
			17	1-20	
			13	50-100	Associated with other decays, mostly Rhizopus rot.
			9	2-33	
Cuba	4	18	4	2-32	Associated with Rhizopus rot.
Florida	168	13	4	56-100	Advanced stages of decay.
			15	29-50	Associated with Rhizopus and other decays in some cars.
			149	1-25	
Louisiana	3	18	3	2-20	Some soil rot in one car.
Mexico	22	9	22	2-22	Soil rot, Rhizopus, and other decays also present.
Mississippi	2	16	2	2-30	
New Jersey	1	25	1	25-30	Sun scald and Phoma rot.
Tennessee	5	8	5	1-17	Associated with Rhizopus.
Texas	14	8	14	2-25	Soil and Rhizopus rots also present.
Unknown	2	11	2	9-13	Rhizopus and soil rot also present.

In the New Orleans market it was observed that reconditioning of many Cuban tomatoes was necessary on account of Phoma rot and that in many cases this resulted in a discard of 25-50% of the fruit.

Regarding the condition of tomatoes received at New York from the Bahama Islands F. C. Meier writes as follows in the Cotton and Truck News Notes of March, 22, 1919.

> "One New York firm continues to receive large shipments of tomatoes from the Bahama Islands, chiefly from the Island of Elluthera. They have planned for about 40,000 crates this season from their plantings, but it is probable that acutal receipts will not reach this mark. Although

> numerous lots have been examined from time to time, Phoma rot and Rhizopus rot seem to have been the only important sources of loss to date. On these shipments Phoma rot alone is causing injury or destruction of approximately 10-40% of stock received."

Soil rot caused by Rhizoctonia sp.

Rhizoctonia, causing a rotting of the fruit or a damping off of seedlings, was reported from Ohio, Florida, Louisiana, and California. Market inspectors found it in cars of tomatoes shipped from Tennessee, Florida, Mississippi, Louisiana, Texas, Arizona, California, Mexico, and Cuba. In these shipments it was usually associated with other types of decay such as those caused by Fusarium, Rhizopus, and Phoma.

The stem rot which was prevalent in southern New Jersey in 1919 was due to Rhizoctonia, attacking the stems at the surface of the ground according to M. T. Cook. The disease evidently originated in the seed bed. The same condition was also found on cabbages in New Jersey.

Collar rot (cause undetermined).

A collar rot of uncertain cause was very prevalent and destructive in southern New Jersey, Delaware, and Maryland. This disease probably played a considerable part in the falling off of tomato production in that area last year. The trouble has been noticed in Delaware for a number of years but never in such a severe form as in 1919. Manns and LeCato in Delaware think it is of bacterial nature. Cook in New Jersey states that the trouble in the southern part of that state last year was due to Rhizoctonia, while Rosenbaum attributed the Delaware disease to Macrosporium solani.

The disease seemed to originate in the seed bed, attacking the plants near the ground level, and causing black cankers. This was carried into the field where the cankers developed further. Temple in Maryland gives the following concerning symptoms:

> "Diseased plants in the field undergo in some cases a lingering death and in other cases they may recover where the plants were set deep enough so that they can send out roots from above the diseased part. The affected portion of the stem is rarely more than two inches in length."

The loss from this disease in Delaware was extremely heavy, being conservatively placed at 25%. Some fields were a complete failure and had to be plowed up. Many farmers in that state planted as high as 80-90% affected seedlings with the result that the stand was cut 20-30% or more.

Tomatoes grown consecutively on the same seed bed showed a much greater infection than those grown on beds properly rotated, according to Manns and LeCato. The cannery run seed also showed greater amounts of disease than northern commercial seed.

Leaf mold caused by Cladosporium fulvum Cke.

Leaf mold was reported, for the most part in greenhouses, from Massachusetts, Connecticut, New York, South Carolina, Ohio, Indiana, Michigan, Missouri, Kansas and Washington. Outbreaks in the field were also noted in Florida and Indiana.

Root knot caused by Heterodera radicicola (Greef.) Müll.

Nematode injury was common on this susceptible crop in the South. It was reported, especially in the sandy soils, from South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Texas, Missouri, California, and Washington. Occurrences in the greenhouse were noted in Ohio and Indiana.

Other diseases.

Damping off, caused by Pythium sp. was reported on seedlings in Washington.

Rhizopus rot, caused by Rhizopus sp., was common in tomato shipments from southern states. Because of the frequent association of this rot with other decays of a similar nature, but caused by other organisms, it is not easy for inspectors to make an accurate diagnosis, to say nothing of being able to estimate the amount of injury from the disease.

Rot, caused by Diplodia sp., was reported by F. C. Meier as follows:

> "On two different occasions Bahama tomatoes were found to be decaying as a result of infection of Diplodia sp. This type of decay progresses rapidly and is very destructive, soon converting the tomato into a blackened mummy with the causal organism fruiting on the exterior. Dr. Rosenbaum isolated a Diplodia from tomato last spring from the vine. This being the case it is possible that the fungus will be found on Florida fruit at destination points. The organism seems to be identical with that causing rot of melon and citrus fruits."

Sclerotium blight, caused by Sclerotium rolfsii Sacc., was reported from Louisiana and Alabama.

Sun scald, produced by exposure to hot sun, was reported as common on fruit in New Jersey, Florida, Ohio, Indiana, California, and Washington. It was particularly bad on plants that were defoliated by Septoria leaf spot.

Anthracnose, caused by Colletotrichum phomoides (Sacc.) Chester, was reported as occurring sparingly in Delaware, Ohio, Indiana, and Missouri. In New Jersey it was said to be abundant and the cause of heavy losses.

Winter blight, bacterial, was reported from Pennsylvania. J. H. Muncie observed typical specimens at Girard in Erie County in early August.

Summer blight, cause unknown, was said by D. J. Milbrath to be common in all sections of California, causing about 3% loss of the vines in the state.

Grand Rapids disease, caused by Aplanobacter michiganensis E. F. S., was found by Muncie near Girard, Pennsylvania. At least 200 plants were badly affected in one ten-acre field.

Brown ring spot, (cause undetermined) was found to be abundant on both green and ripe fruit in a car of Mexican tomatoes inspected by Milbrath in California.

Yellowing, probably due to malnutrition, was noted by R. A. Jehle in North Carolina. The grower said it was worse early in the season but a good many plants outgrew it.

White spot of the fruit, (cause undetermined) was noted by Milbrath in California on a few plants of early varieties. One plant produced 90% spotted fruit. The same trouble was noted by him in a carload of Mexican tomatoes.

Streak (cause undetermined) was reported from Washington, April 4.

Bacterial rots of fruit were reported from New York (in greenhouse) and Delaware (uncommon, 1-2%).

Phytophthora wilt, caused by an undetermined Phytophthora, was reported by Chupp from New York where it did serious damage in certain greenhouses at Ithaca.

Oedema, (non-parasitic), was reported from Washington where it was noted April 10.

Failure to set was one of the chief troubles in the eastern tomato section last year. A peculiar combination of weather conditions at blossoming time was said to be responsible. Complaints of blossom-drop were received from California, where it was said to be general in the early spring fields; from Washington, and from Florida. In the southwestern part of the latter state the dropping of the crown-hand blossoms seemed to be almost universal.

Tip burn, aggravated by dry weather in July, was reported general on the older leaves in Indiana August 15.

Cat face (non-parasitic) was reported as common on certain varieties in Indiana and as very prevalent in Mississippi. From the latter state, Fields reported that the Crystal Spring and Hazelhurst crops suffered heavily. Forty per cent of the fruit in many of the fields in those sections showed the trouble.

In the markets, the food products inspectors found the defect in cars from California (4 cars), Florida (1 car), Missouri (2 cars), New Jersey (3 cars), and Tennessee (7 cars). The average percentage of affected fruit in all these cars was 15%.

Lightning injury cases were reported by Manns and LeCato from Delaware as follows:

> "A very disastrous effect of lightning was observed two miles south of Dover. The rows were about 400 yards long, the wires were not grounded. The lightning struck two rows injuring or killing nearly all of the plants, skipped two rows and hit the fifth, killing practically all of the plants.'
>
> Another, and somewhat similar case, was observed a few miles away."

Growth cracks were common in Vermont according to Lutman, injuring almost 25% of the crop about Burlington and probably causing 5-10% loss. Rapid growth in September, following retarded development in August, is given as the cause. The same trouble was very prevalent in Indiana where it probably injured more fruit than any other condition. Five per cent was estimated by Gardner. This cracking of fruit is common almost everywhere tomatoes are grown for canneries.

Rain injury caused by excessive wet weather proved a calamity to the farmers in Dade County, Florida. According to Rosenbaum the Florida East Coast Growers Association estimated that the East Coast tomato section lost about 60% of its crop from this and attendant injuries. Some growers lost their entire crop. In the Homestead and Redlands districts, the injury was not nearly so great but Peters and Larkin were in the center of the affected region.

DISEASES OF SWEET POTATO

Stem rot cause Fusarium batatis Woll. and F. hyperoxysporum Woll.

In 1919 stem rot was reported from practically all of the states that are important in sweet potato production. Occurrences were reported from the following states: New Jersey, Delaware, Maryland, Virginia, North Carolina, South Carolina, Tennessee, Florida, Alabama, Mississippi, Louisiana, Texas, Oklahoma, Arkansas, Missouri, Kansas, and California.

In the southern tier of states the disease was not mentioned as being especially bad. In most cases it was localized. In Louisiana, however, it was reported as being common and as slowly spreading over the state and thus becoming of increasing importance annually. In the northern sweet potato states, particularly the northeast section, the loss was severe. In New Jersey stem rot was abundant and the cause of heavy losses. In Delaware the disease was said to be on the increase and many fields with as high as 60% of affected plants were reported. On the eastern shore in Maryland the disease was general, causing as much as 50% loss in a few cases. In North Carolina, Arkansas, and Kansas the disease occurred in practically every sweet potato section and in some areas in each state it was severe.

More complete data as to loss from this disease in 1919 will be found in Plant Disease Bulletin Supplement 12, 1920.

The dates when stem rot was first noticed by collaborators are as follows:

March 15	Louisiana	June 26	Mississippi
April 10	Florida	July	Arkansas
June 1	Tennessee	July 11	Oklahoma

Foot rot caused by Plenodomus destruens Harter.

The only reports of this disease received from collaborators in 1919 were from Alabama, where the disease seemed to be causing slight losses locally, and from Oklahoma where a few occurrences were noted.

Black rot caused by Sphaeronema fimbriatum (E. & H.) Sacc.

Black rot occurred widely, as usual, in practically all of the sweet potato states and was reported to the Plant Disease Survey from most of them. State reports indicate that the disease was common and generally distributed throughout the sweet potato sections. It was mentioned by many of the collaborators as being prevalent on slips growing in the seed beds early in the season.

The losses incurred by black rot were large, as it took its toll both in the field and in storage. Undoubtedly, this disease was responsible for greater losses than any other single trouble. Reduction in yield in percentages and bushels by states are given in Plant Disease Bulletin, Supplement 12, 1920.

The following table shows the percentages of decay due to black rot in carloads of sweet potatoes shipped from various states, as reported by inspectors of the Bureau of Markets.

Table 69. Amounts of blackrot in shipments of sweet potatoes as determined by food products inspectors of the Bureau of Markets, 1919.

Origin of shipment	No. of cars with decay	Average percentage of decay	Range of percentage of decay	Remarks as to seriousness of decay.
Arkansas	1	5	5	One or more large spots on affected tubers.
Delaware	3	4	1-7	Two or more spots.
Georgia	2	8	6-10	Affected stock in one car worthless.
Kentucky	1	22	20-25	Associated with soft rot.
Louisiana	1	7	7	Bad.
Maryland	1	2	2	Slight.
New Jersey	1	1	1	Slight.
North Carolina	3	4	2-5	Estimate includes some slimy soft rot
Oklahoma	1	3	3	Slight.
Texas	1	30	30	Two-thirds was bad decay, balance slight.
Virginia	8	17	5-30	Rhizopus included in estimates for nearly every car.

Total number of cars with decay - 23. Total number of cars inspected - 241.

The following dates when the disease was first noted are given by collaborators:

April 15 (in seed bed).. Alabama
May 1 (in seed bed)..... South Carolina
May 17 (in seed bed).... Oklahoma
May 19 (in seed bed).... Mississippi

May..................Louisiana
August 15 (in field)..Tennessee
September (in field)..Arkansas
October (in field)....Georgia

Soil rot caused by Cystospora batata Elliott.

Soil rot is limited in distribution. In 1919 it was reported from New Jersey, Delaware, Texas, and Arkansas. In New Jersey it was occasionally found; and in Delaware it was very severe in spots, sometimes injuring 10-80% of the plants. The average percentage of crop injury in Delaware is placed by T. F. Manns at 4%. In Texas the disease was prevalent, causing a loss of from 2-4% of the crop according to J. J. Taubenhaus. In Arkansas only a trace was reported, occurrences being noted in Jefferson, Sebastian, Crawford, and Washington Counties.

Scurf caused by Monilochaetes infuscans E. and E.

Scurf was reported as very common in New Jersey, Delaware, South Carolina, Georgia, Alabama, Arkansas. Missouri, New Mexico, and California, and was found in carload lots of potatoes shipped from the additional states of North Carolina, Tennessee, and Mississippi. In Delaware 10% of injury to the crop as a whole was reported: in South Carolina 20-25% injury; in Arkansas 10%; and in New Mexico 50%. The losses, however, were not very great although the market grade was considerably lower in some cases and as a rule affected potatoes did not keep so well in storage.

The percentages of potatoes affected with scurf found by market inspectors are shown in the accompanying table.

Table 70. Amount of scurf as determined by inspection of carloads of sweet potatoes by inspectors of the Bureau of Markets, 1919.

Origin of shipment	No. of cars with scurf	Average percentage of scurf	Range of percentage of scurf	Remarks as to seriousness of decay.
Alabama	1	8	8	Bad scurf.
Arkansas	1	17	15-20	
Delaware	4	11	5-17	Heavy spotting covering one-third of surface of tubers.
Georgia	1	50	50	Badly discolored.
Mississippi	1	80	80	Scurf covered one-fourth to three-fourths of affected potatoes.
New Jersey	2	19	15-25	Ranging from small spots to spots covering one-third to two-thirds of surface.
North Carolina	3	23	20-25	Badly spotted.
Tennessee	1	20	20	Covering one-eighth to three-fourths surface of affected potatoes.

Total number of cars with decay - 14. Total number of cars inspected - 241.

Soft rot caused by *Rhizopus nigricans* Ehr.

This was one of the most common and destructive storage rots of sweet potatoes affecting the crop in storage and in transit and in a few cases it was noticed injuring plants in the seed bed. It occurred widely where sweet potatoes are grown and it was probably the most common decay encountered by the inspectors of the Bureau of Markets when examining shipments of potatoes at destination. Table 71 gives the results of car inspection during the calendar year 1919.

Other diseases.

White rust caused by *Albugo ipomoeae panduranae* Farl. was reported from Delaware, Alabama, South Carolina, and Tennessee. It also doubtless occurred in many other sections. The damage done was not great but in Alabama several reports of rather heavy infestation were received. It was said to be severe on Nancy Hall in several counties of Northern Alabama.

Dry rot caused by *Diaporthe batatatis* (E. & H.) H. & F. One report of this disease was received from Lincoln Parish, Louisiana.

Root rot caused by Ozonium omnivorum Shear was reported as prevalent in Texas as usual.

Leaf spot caused by Phyllosticta batatas E. & M. was reported from Alabama (considerable), Ohio (less), South Carolina (common).

Leaf spot caused by Septoria bataticola Taub. was reported as common in South Carolina.

Java black rot caused by Diplodia tubericola (E. & E.) Taub. was reported from Florida where the crop was injured locally. The loss in these local cases was rather large according to C. D. Sherbakoff.

Root knot caused by Heterodera radicicola (Greef.) Müll. was a common injury as usual and was reported from South Carolina (common); Arkansas (general, 5% injury); Missouri (severe in greenhouses and cold frames); and California.

Southern blight caused by Sclerotium rolfsii Sacc. was reported from Alabama but not serious in that state.

Table 71. Amounts of sweet potato soft rot caused by Rhizopus nigricans as determined by food products inspectors of the Bureau of Markets, 1919.

Origin of shipment	No. of cars with decay	Average percentage of deacy	Range of percentage of decay		Remarks as to seriousness of decay.
			No. cars	Percent	
Alabama	13	15	1	60	Some complete.
			12	1-30	Considerable, some slight.
Arkansas	27	14	1	80	All stages.
			5	23-33	Some bad.
			21	2-18	Some bad, mostly slight.
California	5	27	2	32-50	All stages.
			3	12-25	All stages.
Colorado	2	22	-	20-25	
Delaware	5	21	2	30-50	All stages.
			3	5-10	Some bad.
Florida	2	18	-	15-21	Mostly bad.
Georgia	6	13	-	2-19	Mostly complete.
Kentucky	2	27	1	46	Bad.
			1	8	Slight.
Louisiana	9	13	-	2-28	Some bad.
Maryland	4	13	1	45	
			3	2	Slight.
Minnesota	1	2	-	2	Slight.
Mississippi	2	24	-	15-32	All stages.
New Jersey	5	14	1	55	All stages.
			4	1-6	Mostly slight.
North Carolina	26	12	-	2-30	Considerable complete, some slight.
Ohio	1	10	-	10	
Oklahoma	1	22	-	15-25	Bad.
Pennsylvania	1	11	-	10-12	
Tennessee	13	9	-	2-28	All stages, mostly slight.
Virginia	20	8	-	1-25	Some complete, mostly slight.

Total number of cars with decay - 145. Total number of cars inspected - 241.

Charcoal rot caused by Sclerotium bataticola Taub. - reported from Delaware by T. F. Manns as being common in storage houses, sometimes injuring from 1-10% of the potatoes.

Mosaic, cause undetermined, was found in several scattered districts of Arkansas.

Curly leaf, probably caused by unfavorable soil conditions, was reported as occurring locally in Florida.

Storage rot, caused by various organisms, as a group brought about the heaviest losses to the sweet potato crop. Of these rots black rot, soft rot, and others have been reported above but a good many other organisms were also concerned in the work of destruction.

DISEASES OF BEAN

Bacterial blight caused by Bacterium phaseoli E. F. S.

In 1919 bacterial blight probably occurred in all of the states east of Central Nebraska. West of this it was not reported from any state except Colorado where there was very little this year as compared with 1918, when the disease was epiphytotic in the bean growing sections of that state.

Losses occurred in several ways. The injury to the leaves was said to be very marked in Michigan and Pennsylvania. Less damage than usual to the pods was reported from the latter state. Considerable trouble was experienced in Michigan from infections of the nodes with subsequent breaking over of stems. Some fields in that state showed as high as 20% loss from nodal infections.

The losses as a whole were probably somewhat less than in 1918. Estimates of loss in percentages and in bushels are given in Plant Disease Bulletin, Supplement 12, 1920. For convenience the following percentage loss estimates, for states where one or more percentage reduction in yield took place are given.

Table 72. Estimates of loss from bacterial blight of bean in states where one per cent or more reduction in yield took place, 1919.

State	Percent loss	State	Percent loss	State	Percent loss
New York	5	Mississippi	5	Tennessee	5
New Jersey	1	Louisiana	8	Michigan	3
Pennsylvania	5	Texas	3	Wisconsin	4
North Carolina	2	Oklahoma	1	Minnesota	2
South Carolina	3	Arkansas	1	South Dakota	1

The dates when the disease was first observed on bean plants were given by collaborators as follows:

April.....Louisiana	June 18.....Oklahoma	July 7.....Indiana
May.......Arkansas	June 26.....Minnesota	July 23....Ohio
June 1....South Carolina	July........Wisconsin	August 9...Pennsylvania

In Massachusetts and New Jersey the disease was reported as being rather common early in the season, but negligible later on.

Anthracnose caused by Colletotrichum lindemuthianum (Sacc. & Magn.) Br. & Cav.

Anthracnose occurred in, and was reported from, practically all states in the eastern half of the country. It was also of slight occurrence in Arizona. It is rather significant that none was found in Colorado although it was especially looked for, nor was it reported from any of the other western states.

The disease may be said to have been considerably less abundant than usual. This was particularly true in the northeastern and eastern parts of the country. Thus, in Vermont it was said to be scarcer than for several years past, and from Maine, New Hampshire, Massachusetts, Connecticut, New York, Pennsylvania, and New Jersey, similar statements were received. In the southern states where green beans are raised for early markets it seemed to be fully as abundant as usual. In Texas it was very prevalent and affected about 20% of the early snap beans.

In the important bean states of New York, Michigan, and Colorado the disease did not greatly influence the yield of the crop.

Losses of dry and snap beans in percentages and in bushels by states will be found in Plant Disease Bulletin Supplement 12, 1920. The tentative percentage loss estimates, for states where more than 1% reduction in yield occurred, are as follows:

Table 73. Estimates of loss from anthracnose of bean in states where one per cent or more reduction in yield took place, 1919.

State	Percent loss	State	Percent loss	State	Percent loss
Maine	8	Florida	1	South Dakota	5
New Hampshire	3	Mississippi	7	Pennsylvania	5
Vermont	4	Louisiana	2	West Virginia	5
New York	2	Texas	5	Connecticut	2
Virginia	3	Arkansas	2	North Carolina	2
Tennessee	5	Ohio	7	Minnesota	2
South Carolina	1				

Anthracnose was found in carload lots of green beans shipped from trucking centers to city markets. Table 74 gives an idea of the general prevalence of the disease in some of these shipments.

In New England and New York the dry and hot weather was said to be responsible for the small amount of anthracnose. In Wisconsin rainy weather in June favored the disease somewhat at the start, but the dry July checked its spread. In Kansas the weather was said to be favorable for the disease but in spite of that there was very little of it.

The dates when the disease was first noticed on bean plants are given by collaborators as follows:

April 15...Florida
May........Louisiana
May........Mississippi
June.......Wisconsin
June.....South Carolina
June 9...Minnesota
June 23..Pennsylvania
June 26..Ohio
July 1.....New Hampshire
July 25....Georgia
August 2...Tennessee

Very little on varietal susceptibility was reported by collaborators, although Orton in Pennsylvania reported the disease as particularly destructive on Yellow Eye.

Table 74. Amount of anthracnose of bean as shown by examination of cars at destination by inspectors of the Bureau of Markets, 1919.

Origin of shipment	No. of cars with anthracnose	Average percentage of anthracnose	Range of percentage of anthracnose		Remarks as to seriousness of disease.
			No. cars	Percent	
Florida	1	-	-	-	Noticeable amount in every hamper.
Louisiana	6	28	2	50-100	All beans in top, and 50% in lower part, of loads affected.
			1	35-40	Badly decayed.
			2	1-5	Scattering spotted stock.
Maryland	1/2	3	-	3	Badly spotted throughout half of load.
Mississippi	5	13	1	40	In practically every hamper.
			3	1-8	Slight decay.
			1	-	Stock generally had a rusty appearance.
Missouri	1	29	-	25-33	Probably southern grown but reported as coming from Missouri.
South Carolina	1	.3	-	.3	20% of baskets showed 1/3 of contents affected.
Tennessee	1	-	-	-	5% in top of load badly spotted.

Total number of cars with anthracnose - 15 1/2. Total number of cars inspected-48.

Rust caused by Uromyces appendiculatus (Pers.) Lev.

Bean rust occurred in about the same places as usual, although it was probably somewhat less abundant than in 1918. It was reported from Colorado (slight), New Mexico (very common), Kansas, Texas (prevalent on late beans), Louisiana (very common on certain varieties), and practically all other states east of the Missouri and Mississippi Rivers. In the northern section of the United States the disease was probably somewhat less common than usual, although in Wisconsin more than the average was reported. In the south it caused losses to the late planted beans, the early crop escaping injury. Tennessee reported 40% of the late crop affected, Louisiana reported 20-30% of the pole varieties injured, and West Virginia estimated 20% crop injury with 5% loss. In Texas 5% loss to late Kentucky Wonders was recorded while in Georgia 1-2% of the full crop was estimated as lost.

Collaborators mention the disease as first being reported to them as follows:

May 1	Florida
May	Louisiana
July 2	Ohio
July 15	Tennessee
July 15	Virginia
July	Wisconsin
August 1	Georgia
August 19	Minnesota
September 1	Colorado

Only certain varieties were affected with rust, Kentucky Wonder and other pole varieties are mentioned as being especially susceptible in a number of states.

No control measures were mentioned in collaborators' reports of the year.

Mosaic (cause undetermined)

Mosaic had an even wider range than anthracnose or bacterial blight during 1919 as it was reported from a number of western states as well as from the East. Occurrences were reported from Vermont, Massachusetts, Connecticut, New York, Pennsylvania, New Jersey, Virginia, Tennessee, South Carolina, Georgia, Alabama, Mississippi, Louisiana, Texas, Oklahoma, Arkansas, Indiana, Michigan, Wisconsin, Minnesota, Kansas, Colorado, New Mexico, Idaho, and Oregon. Taking the bean crop as a whole it would seem that the disease was somewhat less prevalent than in 1918 although a number of states mention that dry weather tended to obscure the symptoms so that it was difficult to estimate the exact amount of

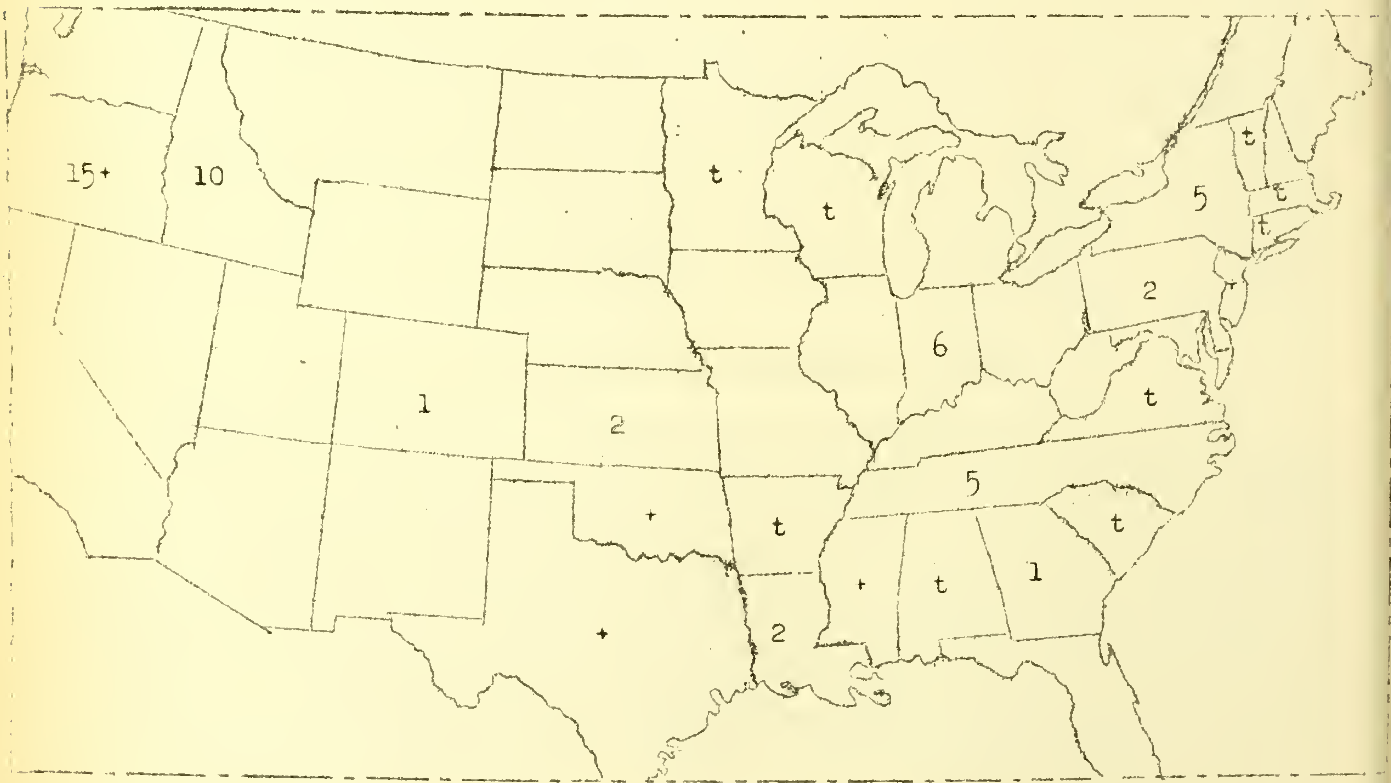

Fig. 41. Estimated percentages reduction in yield of beans from mosaic, 1919.

the disease. In Pennsylvania at least it was much less than last year.

In some states the disease was mentioned as being a rather serious problem. In the bean growing sections of northern Idaho it was general and, according to C. W. Hungerford, probably reduced the crop 10%. In the commercial pea bean section of western New York about 25% of the pea beans were affected with this disease. In Mississippi, where it was common locally, at least one field at Crystal Springs was found with 33% affected plants. Losses in percentages and in bushels will be found in Plant Disease Bulletin, Supplement 12, 1920. The accompanying map, however, gives the tentative estimated percentages of reduction in yield by states.

The dates when the disease was first brought to the attention of collaborators are as follows:

May	Oklahoma	July 2	Colorado
June 1	Tennessee	July 8	Pennsylvania
June 25	Indiana	July 15	Vermont
July	Wisconsin		

The following varieties were reported affected:

Black Valentine	Connecticut
Refugee	University Farm, Minnesota
Kentucky Wonder (late planted)	Texas

No suggestions as to ways in which the disease may be controlled were made by collaborators in reports of 1919.

Powdery mildew caused by Erysiphe polygoni DC.

Powdery mildew was reported from Connecticut, South Carolina, Texas (unimportant), and New Mexico (doing damage in some fields).

Stem rots caused by various organisms.

Stem rots caused especially by Fusarium and Rhizoctonia spp. were reported as occurring rather widely over the country. Trouble of this kind without any cause being mentioned was reported from West Virginia, Tennessee, Georgia, Alabama, Arkansas, and Idaho.

Rhizoctonia sp. was reported as causing root or stem rots in Delaware, New Jersey, Louisiana, Texas, Ohio, Michigan, Colorado, Idaho, and Washington. In most of these states it was not said to be especially serious, but in New Jersey and Delaware considerable damage was reported and in Louisiana the infection was said to be particularly heavy last year, probably on account of the very wet spring; also in Colorado and Idaho root rot, apparently due to Rhizoctonia, was serious where found.

Fusarium sp. was thought to be responsible for certain stem and root troubles in the following states: Massachusetts, New York, South Carolina, Florida, Texas, Oklahoma, Tennessee, Minnesota, North Dakota, Colorado, New Mexico, and Nevada. In New York the cause was Fusarium martii phaseoli and it was said to be present in about 75% of the fields, reducing the yield for the state 10%. In Minnesota a report was received from Carlton County, where it was severe in a field that had been planted to beans for the past few years. In Nevada 10% of the crop in Churchill County was said to be injured by a root rot, probably caused by Fusarium.

Southern blight caused by Sclerotium rolfsii Sacc.

This disease occurred in a number of the southern states and was reported from South Carolina and Georgia, where it was about as prevalent as usual, being present in the majority of garden soils, and from Texas, where it was very prevalent on account of the wet weather, causing an estimated loss of about 1%.

Drop and watery soft rot caused by Sclerotinia libertiana Fckl.

This disease was reported as occurring in the field in Alabama, in the greenhouse in Ohio, and in the markets on beans from various states, as follows:

Table 75. Losses from watery soft rot of beans as shown by examination of cars at destination by inspectors of the Bureau of Markets, 1919.

Origin of shipment	No. of cars with decay	Average percentage of decay	Range of percentage of decay	Remarks as to seriousness of decay.
Alabama	3	3	1-5	Slight decay.
Florida	3	32	1 car 75-100	Heavy decay.
			2 cars 5	Slight decay in small nests.
Georgia	1	55	50-60	Some bacterial decay.
Louisiana	7	6	1-30	Slight decay, in nests.
Maryland	3.5	8	1-25	Decay appeared in nests.
Mississippi	6	7	1-35	Decay slight.
South Carolina	1	1	1	Slight decay.
Texas	1	25	25	

Total number of cars with decay - 25.5. Total number of cars inspected - 48.

Root knot caused by Heterodera radicicola (Greef.) Müll.

Root knot was reported from South Carolina (Coastal Plain Section, where it was common, causing 15% crop injury), Florida (common, considerable on late crop), Louisiana (occasional, injury small), and Arkansas (common, 3% injury).

Other diseases.

Root rot caused by Ozonium omnivorum Shear, - reported from Texas and

Oklahoma.

Streak caused by *Bacillus lathyri* M. & T., - reported as general in Delaware but causing no damage.

Damping off caused by *Pythium* sp. was reported from Delaware where less than 1% was observed in one field.

Leaf spot caused by *Cercospora* sp., - reported as prevalent but unimportant in parts of Eastern Texas.

Leaf spot, cause undetermined,- reported from Pierce County, Washington, June 11.

Angular leaf spot caused by *Isariopsis griseola* Sacc. was reported from Pennsylvania by C. R. Orton. It was collected in the gardens at State College and was generally distributed on a single variety.

Pod blight caused by *Phoma* sp.,- reported as rather general in Georgia and causing quite a little loss.

Chlorosis (non-parasitic) was prevalent in parts of Texas. The condition seemed to be associated with soils that were too rich in lime.

DISEASES OF ONION

Onion smut caused by *Urocystis cepulae* Frost.

Smut of onion was reported in 1919 from Vermont, Connecticut, Massachusetts, Pennsylvania, Ohio, Indiana, Wisconsin, Iowa, Missouri, North Dakota, and Oregon. It was usually localized in certain important onion growing sections. In Vermont an area where the disease occurred was discovered last year in Windham County. In Connecticut the disease was serious. In the onion section of Luzerne County, Pennsylvania, and in the Erie County area it was greatly reduced owing to the increase in the practice of the formaldehyde drip method. In Iowa the disease was rather bad in the Pleasant Valley section.

As a whole, the losses were probably about the same as usual, but it was reported from Massachusetts that losses ran higher than normal on account of the wet season. Pennsylvania reported less than usual and Ohio and Oregon reported more. In the latter state it was mentioned that smut was growing worse. Soil disinfection methods for Oregon conditions have not been perfected so as to result in satisfactory control on a practical basis.

Regarding the extent of the losses, C. R. Orton in Pennsylvania reported as high as 20% infection in Luzerne County. In the Chicago onion set district J. C. Walker noted from 50-90% losses of the stand in large areas. He estimated that the average reduction to the crop for that section was about 5%. In Ohio approximately 1% of the crop was reported affected.

In general formaldehyde soil treatment was reported as giving good results. In Massachusetts, Osmun reported gains in yield of from 125% to 345% on one series of experimental plots. In Wisconsin R. E. Vaughan reported results of demonstrations on smut control as follows:

Bulb onions, soil treated	- 212 bushels
Bulb onions, soil not treated	- 50 "
Set onions, soil treated	- 256 "
Set onions, soil not treated	- 128 "

In Racine and Kenosha Counties, Wisconsin, it was estimated by Vaughan that the formaldehyde drip was used on about 100 acres of onions. In the Chicago set district mentioned above Walker stated that the use of formaldehyde drip was very limited, but on account of certain convincing demonstrations of 1919, the onion set contractors will begin to use this method more extensively.

Downy mildew caused by *Peronospora schleideni* Ung.

Downy mildew was mentioned as having occurred in 1919 only in the states of Pennsylvania, North Dakota, Louisiana, California, and Washington. In California it caused considerable damage to the seed crops in the Santa Clara Valley, according to D. G. Milbrath, but in the other states the loss was evidently very slight.

Neck rot causec by *Botrytis* sp.

In the field onion neck rot was reported from Ohio, Illinois, Wisconsin, North Dakota, Washington, and Louisiana. Owing to the extremely dry weather of last summer the disease was much less common than usual in the Illinois and Wisconsin onion sections, and in the other states the disease was mentioned as being of only slight importance.

In carload shipments of onions, however, this disease was serious. Inspectors of the Bureau of Markets examining cars in various cities found it common in carloads from many different states. The results of their inspection are given in the following table:

Table 76. Percentages of onion neck rot as determined by food products inspectors of the Bureau of Markets, 1919.

Origin of shipment	No. of cars with decay	Average percentage of decay	Range of percentage of decay	
			No. cars	Percent
Alabama	1	-	-	-
California	24	8	1	70
			23	2-19
Colorado	3	16	1	42
			2	3
Georgia	1	-	-	-
Illinois	18	9	1	57
			17	1-25
Indiana	1	3	1	3
Iowa	5	6	5	2-10
Kentucky	16	25	8	30-60
Louisiana	1	12	1	0-25
Massachusetts	4	3	4	1-4
Michigan	3	4	3	2-7
Minnesota	2	2	2	2
Missouri	1	3	1	2-4
New York	7	8	7	2-20
Ohio	11	6	11	2-15
Oregon	7	5	7	2-12
Texas	13	9	1	45
			12	2-15
Washington	5	3	5	2-5
Unknown	1	12	1	12
Spain	1	22	1	22

Total number of cars with decay 125

Total number of cars inspected 1542

Leaf spot caused by *Macrosporium* sp.

In Louisiana this leaf spot is very common on the seed onion crop. It is estimated that not less than from 25-50% of the seed crop was lost on account of it and possibly other associated and contributing causes. Last year, however, was not such a bad year so far as this disease was concerned. It attacks the stems, covering them with a black mold and causing them to rot and fall over. Spraying with Bordeaux is only fairly satisfactory according to C. W. Edgerton.

Macrosporium was also reported from Missouri and Indiana.

Smudge caused by *Vermicularia circinans* Berk.

Smudge was reported as occurring to some extent on White Globe onions in the Indianapolis market garden section of Indiana, in the Chicago set district of Illinois, in the Racine set section of Wisconsin, and in Oklahoma on white onions.

Black mold caused by *Aspergillus niger* Van Tieghem.

Black mold was reported again from California this year by D. G. Milbrath and J. C. Walker. Sixty per cent infection in the Delta region and 10% infection in the Coachella section were reported by D. G. Milbrath. The actual loss from this infection is very difficult to estimate.

This disease was found occurring in a considerable number of cars of onions examined by inspectors of the Bureau of Markets, particularly in cars shipped from California and Texas. Their results are given in the following table:

Table 77. Percentages of black mold caused by *Aspergillus niger* as determined by examination of cars at destination by food products inspectors of the Bureau of Markets, 1919.

Origin of shipment	No. of cars with decay	Average percentage of decay	Range of percentage of decay		Origin of shipment	No. of cars with decay	Average percentage of decay	Range of percentage of decay	
			No. cars	Percent				No. cars	Percent
California	28	15	3	70-80	Texas	15	15	1	90
			25	1-26				14	2-28
Illinois	1	25	1	25	Unknown	4	13	4	2-30
Indiana	1	15	1	10-20					
New York	2	27	1	50	Total number of cars with decay	51			
			1	4	Total number of cars inspected	1542			

Pink rot caused by *Fusarium malli* Taub.

This disease was reported from Texas as usual, causing a loss of 5%, and from San Joaquin County, California, by Miss E. H. Smith, and also by J. C. Walker as follows:

> "Pink rot appeared for the first time in conspicuous form in the Stockton, California, region. I saw one holding of 2500 acres of onions where it was appearing in spots and causing premature dying of the plants. In this instance it was estimated that about 20 acres were affected to such an extent that the crop would be reduced 50% in these places."

Pink rot apparently caused by _Fusarium_ sp. was also found locally in Indiana. A Fusarium bulb rot was collected in Illinois, Indiana, and Washington.

Watery soft rot caused by _Sclerotinia libertiana_ Fckl.

Watery soft rot was found in five cars of onions inspected by the Bureau of Markets inspectors. These cars originated in California, Illinois, and Texas, and showed rot ranging from 5 to 47%.

Root knot caused by _Heterodera radicicola_ (Greef.) Müll.

Root knot was collected by C. T. Gregory at Akron, Indiana, and reported by him to the Plant Disease Survey. Speciamens were identified in the Office of Soil Technology of the Bureau of Plant Industry.

Other diseases.

Rhizoctonia on onions was collected in Washington.

Rust (_Puccinia porri_ Sow.) An unusually large amount of this rust was found at one place in Connecticut, and it was collected for the first time in Nebraska, according to a report from that state.

Tip burn (non-parasitic) was very prevalent in Indiana, causing as high as 50% loss in some cases and probably reducing the yield for the state about 2%.

Dodder (_Cuscuta_ sp.) was collected in Walla Walla County, Washington.

DISEASES OF CRUCIFERS

CABBAGE and CAULIFLOWER

Club root caused by _Plasmodiophora brassicae_ Wor.

In 1919 club root was reported mostly from the eastern part of the country where it occurred in Vermont, Massachusetts, Connecticut, New Jersey, Pennsylvania, Delaware, West Virginia, Kentucky, Ohio, Indiana, Michigan, Wisconsin, South Carolina, and Georgia. It was also reported from Washington. In Vermont Connecticut, and Ohio it was found on cauliflower as well as on cabbage.

It was reported not to have been observed in New Hampshire, Tennessee, Alabama, Minnesota, Iowa, Arkansas, Louisiana, Texas, Kansas, and Colorado.

Although the disease was rather generally distributed in some states, the loss due to it was not usually reported to be important. In Vermont it was estimated at from 1-5%, in Pennsylvania at 5%, and in Georgia at from 2-3%. In Massachusetts it was said to be as high as 90% in some fields.

The use of heavy applications of lime was said to give good, although by no means perfect results in controlling the disease in Massachusetts and Ohio.

Yellows caused by Fusarium conglutinans Woll.

Yellows was found in 1919 in most of the central, southern, and western states - practically the same distribution as in 1918. It was reported not to have been observed in the New England States, Colorado (present in 1918), and Washington. It was reported from New Jersey, Pennsylvania, Delaware, Maryland, Virginia, Georgia, Alabama, Mississippi, Tennessee, Kentucky, West Virginia, Ohio, Indiana, Illinois, Michigan (? - one suspected case), Wisconsin, Iowa, Nebraska, Kansas, Missouri, Arkansas, Louisiana, Texas, and Oklahoma.

The disease was apparently less serious than usual in Pennsylvania, Wisconsin, and Alabama. In Indiana, Tennessee, Mississippi, Louisiana, Texas, Arkansas, and Kansas, on the other hand, it seemed to be increasing in prevalence and severity. In Indiana it was said to have become the limiting factor in the growing of cabbage for market. In Mississippi it was the most prevalent and most destructive disease of cabbage, causing a loss of possibly 5%. In Louisiana it was very abundant and caused considerable loss. The practice of using plants shipped in from other states was thought to be responsible for the very rapid spread of the disease in that state. In Kansas yellows was said to be more prevalent than ever before, causing losses ranging from 10-50%. In Arkansas the loss was estimated at 10%, and in Texas at 4%. In Tennessee the disease was very common, and particularly destructive in the western section, where it caused losses in some cases as high as 90%. In Maryland, Ohio, Iowa, and Georgia, the disease was about as prevalent as usual and caused considerable losses, 10% being estimated in Georgia. In the other states where it occurred it was local or where general caused only slight losses.

Dates when the disease was first noticed were reported as follows:

April	Louisiana
May 17	Oklahoma
May 28	Georgia
May	Mississippi
June 15	Missouri
June 17	Indiana
June 18	Ohio
June	Wisconsin
August 30	Pennsylvania

In Indiana the varieties Copenhagen and Wakefield were severely affected, while Louisville showed resistance. The use of wilt resistant strains was said to be responsible for the small loss in Wisconsin, and they also gave good results in Ohio. It is apparently the only successful method of controlling this disease. Crop rotation does not seem to eliminate it. One case, said to be authentic, was reported from Ohio where the organism remained in the soil after a nine year period of rotation.

Black-leg caused by *Phoma lingam* (Tode.) Desmaz.

Black-leg was reported from New Jersey, Pennsylvania, Delaware, Maryland, South Carolina, Ohio, Indiana, Kentucky, Wisconsin, North Dakota, Iowa, Missouri, Arkansas, Alabama, Mississippi, and Louisiana. It was reported not to have been found in New Hampshire, Vermont, Massachusetts, Connecticut, Tennessee, Michigan, Minnesota, Oklahoma, Colorado, Washington, and Oregon.

In Pennsylvania the disease was apparently more prevalent than usual. In Wisconsin it was said to be one of the most destructive diseases of cabbage, causing heavy losses especially in the Outagamie and Brown County districts, where it was more severe than in Racine and Kenosha Counties. The disease caused losses also in New Jersey, Maryland, South Carolina, Iowa, Missouri, Arkansas, Mississippi, and Alabama. In the other states where it occurred it was present in small amounts and caused no loss.

The disease was first reported on the following dates:

May	South Carolina	July 10.............	Ohio
May.............	Wisconsin	July 19.............	Indiana
June 1..........	Missouri	October 10..........	Pennsylvania

The heavy spring rains in Wisconsin favored the spread of the disease. According to J. C. Walker (Phytopath. 10: 64, 1920), "Rainy periods seem essential for dissemination of the fungus from primary centers. Correlation of rainfall and occurrence of disease in various localities indicates that weather conditions during growth of seed bed are very important in development of epiphytotics."

In Pennsylvania the Danish Ball Head and Danish Round Head varieties were apparently most susceptible.

Seed sterilization was said to give good results in Arkansas. In Wisconsin, on the other hand, the disease was prevalent in spite of seed disinfection. J. C. Walker reported that "Seed treatment within limits of injury to germination is not completely effective."

Black rot caused by *Bacterium campestre* (Pam.) E. F. S.

In 1919 black rot was found in Massachusetts, Connecticut, New Jersey, Pennsylvania, Delaware, Virginia, South Carolina, Florida, Ohio (also on cauliflower), Indiana, Wisconsin, Missouri, Kentucky, Tennessee, Louisiana (specimen collected by L. R. Hesler and identified in the Office of Cotton, Truck, and Forage Crop Disease Investigations), Texas, Oklahoma (one report), Kansas, and Nebraska. In Colorado it was said to be probably present, although it had not been observed.

It was reported not to have been found in New Hampshire, Vermont, Iowa, Arkansas, and Washington.

The disease was said to be general in Pennsylvania, Virginia, Tennessee, Wisconsin, Missouri, and Texas. In Pennsylvania the loss caused was estimated at 7.5%, and in Tennessee it ranged from 10-25% in infested fields. In Wisconsin, where it was thought to have been introduced with infected seed, it was said to be one of the most important diseases, causing losses as high as 70% in some fields, though the average loss was moderate. In other states black rot was not reported to be especially important, although in some cases individual fields were severely infested.

Heavy rains in Wisconsin caused widespread infection. In the same state seed treatment with mercuric chloride proved very satisfactory as a means of control.

This rot did not seem to be prevalent or important on cabbage in transit. It was reported in only four cars (from Alabama, Michigan, New York, and Virginia) out of a total of 1423 cars examined by inspectors of the Bureau of Markets.

Damping-off caused by Corticium vagum solani Burt.

Rhizoctonia was reported from New Jersey, Florida, Ohio, Indiana, Missouri, and Washington. In most cases it occurred as a damping-off fungus, but in Washington it caused a root-rot also. In all cases it was local in distribution and did little damage. Seed bed sanitation and proper cultural methods were recommended from Florida as a means of control.

Root knot caused by Heterodera radicicola (Greef.) Müll.

Root knot was reported only from South Carolina and Texas in 1919. In the former state it was said to be common, causing 25% injury to the crop and a loss estimated at 2%. In Texas it was unimportant, occurring only in traces.

Downy mildew caused by Peronospora parasitica (Pers.) De Bary.

Downy mildew was reported as local and unimportant in South Carolina, Alabama, Mississippi, Iowa, and Texas. According to D. C. Milbrath, the disease was prevalent and severe on cauliflower in the vicinity of Sacramento, California.

Slimy soft rot caused by Bacillus carotovorus Jones.

Slimy soft rot was a rather important field disease in Vermont, Pennsylvania, and Louisiana, causing damage estimated at 2-5% in Vermont and 5% in Pennsylvania, and also causing considerable loss in Louisiana. In Pennsylvania it was said to be more prevalent and more destructive than was generally supposed. The disease was found also in the field in Delaware and Kentucky, where it was not important: in Ohio, where it was said to be more prevalent than usual; and in Wisconsin, where, although common, it caused very slight loss.

Slimy soft rot was very prevalent on cabbage in transit, being found in practically every car inspected. In some cases it caused severe losses but in the majority of instances only a few outer leaves were involved.

Black mold caused by Alternaria brassicae (Berk.) Sacc.

Black mold or black leaf spot was reported from Pennsylvania, Delaware, South Carolina, Florida, Ohio, Kentucky, Indiana, Wisconsin, Alabama, Mississippi, Louisiana, Texas, and California. In South Carolina the loss caused was estimated at 1%, in Georgia at from 2-3%, and in California at 3% in the vicinity of San Francisco, where it was also prevalent on broccoli, according to D. G. Milbrath. At Los Angeles it occurred on cauliflower.

The disease did not seem to be important in the other states from which it was reported.

Black mold occurred on cabbage and cauliflower in trnasit, but in most cases reported the damage was slight, affecting mostly the outer leaves.

Other diseases and injuries.

Leaf spot caused by Bacterium maculicolum McCulloch was reported as general in southern Alabama. A disease thought to be due to the same organism was observed by L. R. Hesler in the vicinity of Crystal Springs, Mississippi; New Orleans, Louisiana; and Houston, Texas. Specimens of the disease on cauliflower were received by Miss McCulloch from New York and Florida.

Drop caused by Sclerotinia libertiana Fckl. was reported from Indiana, Alabama, Mississippi, Louisiana, Texas, and California. It was apparently not important in the field except in Louisiana, where it caused a loss estimated at 10%, and in Texas, where it was said to be present in every field, In Alabama it was said to be "conspicuous by its absence", only traces having been found on cabbage.

Wilt caused by Sclerotium rolfsii Sacc. was reported from Texas and Alabama as unimportant.

Pleospora sp. was reported by D. G. Milbrath as "frequent in conjunction with other diseases" in California.

Powdery mildew, probably caused by Erysiphe polygoni DC., was reported by L. R. Hesler to be severe on occasional plants in nearly every field of early cabbage in the vicinity of San Benito, Texas.

Ring spot caused by Mycosphaerella brassicicola was found by D. G. Milbrath to be severe during all seasons of the year on cabbage, cauliflower, and broccoli, both in the field and in transit, in the vicinity of San Francisco. The loss caused was estimated at 30%.

Decay caused by Botrytis sp. was reported by D. G. Milbrath as frequent in late cabbage (maturing in May, June) in southern California; and also earlier in the year following ring spot and causing slimy rot.

Leaf spot caused by an undetermined species of Phoma was found at Mt. Vernon, Skagit County, Washington.

Leaf infection by Fusarium sp. was reported by D. G. Milbrath from California as severe on cabbage and broccoli in conjunction with Mycosphaerella and Alternaria.

A purple spotting, thought not to be due to Phoma, of the stems and branches of cabbage was found occasionally in Washington.

A leaf spot resembling the Alternaria leaf spot was said to be common in the vicinity of La Conner, Washington.

"Leaf speck", cause unknown, was locally rather severe in Florida, according to G. K. K. Link.

An undetermined disease of cabbage was reported by L. R. Hesler as general in Louisiana in the region south of New Orleans, affecting 75% of the plants in some fields. It caused a brownish spot bordered by a yellow band, usually appearing at the margin of the leaves. It was said to resemble slightly a condition found in the same state in 1918.

A peculiar trouble of unknown origin, which caused a thickening and mottling and finally the death of the leaves, was found by L. R. Hesler near Crystal Springs, Mississippi.

An undetermined root rot was reported from Nebraska.

Tip-burn (non parasitic) was reported from Indiana (not common).

Nitrate injury was reported from Alabama. According to L. R. Hesler the injurywas in some cases confused with that caused by downy mildew, bacterial blight, and black mold; although in other cases it was evidently due to nitrate burning.

Lightning injury, which caused the death of all plants in an area probably 30 feet in diameter, was reported from the vicinity of Crystal Springs, Mississippi, by L. R. Hesler.

CHINESE CABBAGE (Brassica pekinensis)

Leaf spot caused by Cylindrosporium brassicae was reported from Missouri (rare; 60% injury where found).

HORSE RADISH

White rust caused by Albugo candida (Pers.) Roussel was reported from Ramsey County, Minnesota.

Root rot caused by Thielavia basicola (B. & Br.) Zopf. was said to be very common in one locality in New Jersey.

Leaf spot caused by Alternaira brassicae (Berk.) Sacc. was reported from Missouri (Scott County; local, damage slight).

Leaf spot caused by Cercospora armoraciae Sacc. was reported from Scott County, Missouri.

A bacterial root rot was reported from New Jersey as very common and destructive in one locality.

Black streak, cause undetermined, was reported from Pierce County, Washington.

KALE

Club root caused by Plasmodiophora brassicae Wor. was reported from King County, Washington.

Yellows caused by Fusarium conglutinans Woll. caused considerable loss locally in Indiana. It was said to be especially common on kale following badly diseased cabbage.

Rhizoctonia was reported from Washington.

MUSTARD

White rust caused by Albugo candida (Pers.) Roussel,- reported from

Minnesota on Brassica nigra.

Wilt caused by Fusarium sp., - reported from North Dakota.

RADISH

Club root caused by Plasmodiophora brassicae Wor. was reported from Minnesota (Ramsey County).

Black root caused by Rheosporangium aphanidermatus Edson was said to be very severe in certain market gardening sections of Indiana, particularly on clay soil. White varieties were most affected. The disease was severe also in Mississippi at Long Beach, where in one field at least 75% of the radishes were badly diseased.

White rust caused by Albugo candida (Pers.) Roussel was reported from Indiana (common in greenhouses), Minnesota (slight), Mississippi (heavy infection at Long Beach), and North Dakota (Cass County, slight).

Crown rot caused by Sclerotinia sp. was reported from Indiana, where it was found occasionally in greenhouses on the white varieties.

Scab thought to have been caused by Actinomyces scabies (Thax.) Güssow was reported from Indiana (rare, no loss).

RUTABAGA

Black rot caused by Bacterium campestre (Pam.) E. F. S., - reported from Minnesota.

Powdery mildew caused by Erysiphe polygoni DC.,- reported from Washington.

Leaf spot, said to be similar to that caused by Cercospora on turnip, was reported by L. R. Hesler as causing moderate damage in a planting at Long Beach, Mississippi.

TURNIP

Black rot caused by Bacterium campestre (Pam.) E. F. S.,- reported from Minnesota (Beltrami County, October 30).

Soft rot caused by Bacillus carotovorus Jones,- reported from Alabqma (Chilton County).

Club root caused by Plasmodiophora brassicae Wor.,-reported from Connecticut (one report in old soil, little injury).

White rust caused by Albugo candida (Pers.) Roussel was reported by L. R. Hesler from Mississippi and Louisiana. It caused little damage.

Downy mildew caused by Peronospora parasitica (Pers.) De Bary was reported by L. R. Hesler as generally prevalent but causing little damage in the vicinity of Dickinson, Texas.

Powdery mildew, probably caused by Erysiphe Polygoni DC. was reported from Texas by L. R. Hesler (traces observed in every patch visited, not doing any apparent damage).

Cercosporella albo-maculans E. & E.,- reported from Mississippi (one report; Lawrence County).

Leaf spot, thought to have been caused by Cercospora sp.,- reported from Mississippi by L. R. Hesler.

Leaf spot, caused by Macrosporium herculeum E. & M.,- reported from Alabama (Washington County).

An Alternaria leaf spot said to be abundant in nearly every field was collected in Texas by L. R. Hesler.

Root knot caused by Heterodera radicicola (Greef) Müll. was said to be common in South Carolina, causing a loss estimated at 1%.

DISEASES OF CUCURBITS

CANTALOUPE

Leaf blight caused by Alternaria brassicae nigrescens Pegl.

In 1919 leaf blight was reported to be abundant and prevalent, as usual, in New Jersey, Delaware, Indiana, Arkansas, Texas, and Southern California. The greatest amounts of injury to the crop were reported from Delaware (10-20%) and from Indiana (80%). In Arkansas leaf blight was said to have caused less damage then usual, although it was the most serious disease of cantaloupe in that state. The injury in Arkansas was estimated at 5%. In Texas a loss of 2% was reported. It was also reported from Wisconsin, causing slight damage.

In Arkansas the Pollock resistant strains, said to have been used almost exclusively by growers, and the favorable weather conditions reported, were probably factors in reducing the loss from the disease.

Bacterial wilt caused by Bacillus tracheiphilus E. F. S.

In 1919 bacterial wilt was reported from Connecticut, New Jersey, Pennsylvania, Delaware, Virginia, South Carolina, Ohio, and Indiana. In most of these states it was local in distribution, but in New Jersey it was said to be common and sometimes destructive. In Delaware also it was common on susceptible varieties, such as Honey Dew, causing injury estimated at 1-2%. In Indiana it was the most serious disease of cantaloupe, and was said to be even more serious than usual in 1919.

Anthracnose caused by Colletotrichum lagenarium (Pass.) Ell. & Hals.

Anthracnose was reported from New Jersey, Delaware, Virginia, South Carolina, Georgia, Florida, Ohio, Wisconsin, Minnesota, Tennessee, Arkansas, Texas, and Oklahoma. In most of these states it was local or unimportant, but in Delaware and Georgia the damage due to it was estimated at from 3-5%

and at 25%, respectively; and was reported to be causing considerable loss in Minnesota, in spite of spraying with Bordeaux, which had been practiced for several years. The use of Bordeaux was also said to be only fairly successful in controlling the disease in Florida.

Inspectors of the Bureau of Markets reported anthracnose to be causing bad decay in shipments of cantaloupes from Colorado (5 cars) and from Maryland (one car).

Mosaic (cause undetermined).

Mosaic was reported as local or unimportant in Connecticut, New Jersey, Indiana, Wisconsin, and Texas. In Maryland the disease caused a loss estimated at 2%. In California, the disease was very serious in the San Joaquin Valley in the vicinity of Turlock, where about 7000 acres of cantaloupes are grown. According to D. G. Milbrath, the average loss in that section was 60%, with total losses in some fields. The loss in casaba melons in the same region was 5%.

Downy mildew caused by Pseudoperonospora cubensis (B. & C.) Rostow.

Downy mildew was reported in 1919 from Connecticut, New York, New Jersey, Delaware, South Carolina, Georgia, and Florida. In Delaware and South Carolina the disease was local. Some injury was reported from Connecticut and New Jersey; and in Florida the loss was estimated at 5-10%. In New York it was said that considerable damage was caused by this disease in Columbia County, when spraying was not practiced.

The use of Bordeaux mixture was said to be fairly successful in controlling the disease in Florida.

Southern blight caused by Sclerotium rolfsii Sacc.

Southern blight was reported as local in South Carolina; and prevalent in Georgia and Texas, causing losses estimated at 15% in the former, and 1% in the latter state.

Wilt caused by Fusarium niveum E. F. S.

Fusarium wilt was reported from South Carolina, Ohio, Louisiana, and California. In no case was it said to be important.

Fruit rot caused by Fusarium sp. and Botrytis sp.

The most important of the various fruit rots of cantaloupe reported as contributing to losses in transit were caused by Fusarium sp. and Botrytis sp. The following tables show losses due to these two organisms as reported by inspectors of the Bureau of Markets.

Table 78. Losses from Fusarium rot caused by *Fusarium* sp. as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	No. of cars with decay	Average percentage of decay	Range of percentage of decay		Remarks as to seriousness of decay.
			No. cars	Percent	
Arkansas	15	5	–	1-20	Mostly slight decay.
Arizona	3	12	1	10-20	Fusarium and black rot.
			2	3-25	Fusarium rot only.
California	24	11	–	2-40	Most of cars onlyslight decay.
Colorado	4	5	1	8-10	Fusarium and Rhizopus rots.
			3	2-5	Slight decay.
Delaware	2	6	–	1-10	Slight decay.
Georgia	1	45	–	10-60	Heaviest decay in two upper layers.
Maryland	4	36	1	90	Mostly anthracnose associated with Fusarium and gray mold rots.
			3	8-30	

Total ... 53 Total number of cars inspected 572

Table 79. Losses from gray mold rot caused by *Botrytis* sp. as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	No. of cars with decay	Average percentage of decay	Range of percentage of decay		Remarks as to seriousness of decay.
			No. cars	Percent	
Arizona	2	6	–	2-10	Slight decay.
California	16	41	3	60-100	All stages of decay.
			4	33-50	Mostly superficial decay.
			9	2-13	Mostly slight decay.
Delaware	1	2	–	2	Slight decay.
Maryland	5	25	1	90	Heavy decay, mostly complete. Estimate of decay includes other rots.
			4	2-20	
Michigan	1	100	–	100	Superficial mold, affecting appearance only.
New Mexico	3	12	–	5-20	
North Carolina	2	83	–	66-100	

Total ...... 30 Total number of cars inspected 572

Other diseases.

Leaf blight, cause not given, was reported as causing considerable loss in Maryland. One field was said to be a complete loss.

Tip burn, cause unknown, was common and serious in Indiana, probably because of drought in July.

Bacterial soft rot was reported by inspectors of the Bureau of Markets to be causing decay in 9 cars, from the following states: Arkansas, 1 car; California, 5 cars; Delaware, 2 cars; and Georgia, 1 car.

Root knot, caused by Heterodera radicicola (Greef.) Müll., was said to be common in South Carolina, causing a loss of 3%. D. G. Milbrath reported that in the Imperial Valley of California it caused a loss of 60% in some fields, averaging 5%; and in the vicinity of Turlock, in the same state, the loss due to this disease was 1%.

CUCUMBER

Bacterial wilt caused by Bacillus tracheiphilus E. F. S.

Bacterial wilt was reported in 1919 from Connecticut, New Jersey, Pennsylvania, Delaware, Virginia, South Carolina, Ohio, Indiana, Michigan, Wisconsin, Iowa, Missouri, Kansas, Texas, Arizona, and Colorado. The report from Arizona is the first received by the Survey from that state. A disease which was thought to be bacterial wilt was observed in Louisiana.

In Connecticut, South Carolina, Ohio, Michigan, Wisconsin, Iowa, Missouri, and Texas, the disease was of no particular economic importance, although in Wisconsin it was said to be much more prevalent than usual. Indiana, where it was serious, also reported more than usual, especially in greenhouses. Estimated losses were reported from some of the other states as follows: Pennsylvania (50% in Lehigh and Philadelphia Counties), state average 3%; Louisiana 5%; Colorado 5-10%; Arizona (50-60% in two counties), state average 3%.

Dates when the disease was first observed were reported by collaborators as follows:

July 1 (greenhouse)...Connecticut
July 2 ....Wisconsin
July 24.............. Colorado
August 9 .... Ohio
August 30......... Pennsylvania

Mosaic (cause undetermined)

Mosaic was reported from Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, South Carolina, Florida, Ohio, Indiana, Michigan, Wisconsin, Minnesota, Iowa, Louisiana, Texas, and Kansas.

Connecticut, New Jersey, and Michigan reported less than usual. In Indiana, also there was less mosaic in the field, but in greenhouses it caused considerable loss. In Wisconsin the disease, although widespread, appeared too late in the season to do much damage. From Massachusetts mosaic was reported as more prevalent than usual and as causing large losses in the field.

In the other states from which it was reported it occurred about as usual, and was apparently not important except in New York and in Pennsylvania where the loss in Northampton County was estimated at 25%.

In parts of Wisconsin mosaic was found affecting wild cucumbers more severely than the cultivated plants. Experiments by Doolittle have shown that the disease is carried by insects from the wild to the cultivated plants.

Anthracnose caused by Colletotrichum lagenarium (Pass.) Ell. & Hals.

Anthracnose was reported from Massachusetts, New Jersey, Pennsylvania, Virginia, South Carolina, Ohio, Indiana, Wisconsin, Minnesota (not reported but probably present), Iowa, Alabama, and Texas; and from Arizona and North Dakota for the first time.

The disease was mostly local, or where general caused slight damage, but in New Jersey it was said to be severe, and in Indiana it was rather serious in greenhouses, especially where an overhead system of irrigation was used.

Anthracnose caused some loss in shipments of cucumbers, as shown in the following table:

Table 80. Losses to cucumber from anthracnose caused by Colletotrichum lagenarium as determined by inspectors of the Bureau of Markets, 1919.

Origin of shipment	No. of cars with decay	Average % of decay	Range of percentage of decay
Florida	5	28	2 cars - 2-3 3 cars - 30-65
New York	1	10	10
North Carolina	1	10	10

Total number of cars with decay - 7. Total number of cars inspected - 111

Dates of first appearance of the disease were reported as follows:

June 2......... Ohio
June 18........ Indiana
August 25......... Wisconsin
August 30......... Pennsylvania

Seed treatment and crop rotation were said to give good results in Wisconsin, but as the disease gave little trouble, these measures were not generally practiced.

Downy mildew caused by Pseudoperonospora cubensis (B. & C.) Rostow.

In 1919 downy mildew was reported from Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, South Carolina, Georgia, Florida, Louisiana, Arizona, and California. Arizona reported the disease to the Survey for the first time. Although not reported as occurring in West Virginia, it was probably present to an injurious extent in some sections, according to N. J. Giddings.

In Massachusetts the disease appeared too late to cause much reduction.

of the crop, and in North Dakota the dry season prevented its general development. In other states it caused more or less injury, resulting in considerable losses in some cases, especially in Florida in the late crop, Arizona, and California. In Arizona the loss in one county was estimated at 40%. In California D. G. Milbrath reported 30% loss in the vicinity of Alameda.

Spraying with Bordeaux gave satisfactory results in Florida. Dusting with sulphur, which was practiced in California injured the foliage and was not successful in controlling the disease.

Angular leaf spot caused by Bacterium lachrymans E. F. S. & Bryan.

Angular leaf spot was reported from South Carolina, Michigan, Indiana, Wisconsin, Iowa, and North Dakota (first report received by the Survey). It was unimportant in most cases, but in South Carolina it caused a loss of 10% in field and shipments.

One case was reported from Michigan where the disease had developed in new ground from three year old seed.

Scab caused by Cladosporium cucumerinum Ell. & Arth.

Scab was reported as follows: Pennsylvania (very generally prevalent on about 100 acres in Cambria County near Johnstown where the average loss was 50%; weather conditions apparently very favorable for the disease; reported September 18); South Carolina (local); Wisconsin (several reports received; evidently doing some damage in isolated fields; loss a trace; reported in August).

Other diseases

Leaf spot caused by Alternaria brassicae nigrescens Pegl. was said to be severe in New Jersey.

Stem rot caused by Sclerotinia libertiana Fckl. was reported from New Jersey, where it was occasionally severe in the field, probably due to wet weather. A fruit rot due to this fungus caused losses in carlot shipments from various states, as shown in the following table:

Table 81. Losses from watery soft rot of cucumber caused by Sclerotinia libertiana as determined by food products inspectors of the Bureau of Markets, 1919.

Origin of shipment	No. of cars with decay	Average % of decay	Range of percentage of decay
Arkansas	1	2	2
Florida	1	10	5-15
Louisiana	3	13	8-22
Missouri	1	11	10-12
New York	1	1	1
Unknown	2	38	1 car - 5 1 car - 70

Total number of cars with decay - 9. Total number of cars inspected - 111

Damping-off caused by Pythium debaryanum Hesse was reported from Minnesota (severe infection during rainy weather of June in the plots on University Farm).

Damping-off caused by Rhizoctonia sp. was reported from Washington (Island and King Counties; first report June 16).

Wilt caused by Fusarium niveum E. F. S. was reported from Ohio.

Soft rot caused by Bacillus sp. was said to be common in Florida in Pasco and De Soto Counties. Control measures recommended were spraying the plants with Bordeaux and sanitary packing of the fruit.

Root knot caused by Heterodera radicicola (Greef.) Müll. was reported as follows: Florida (a three-acre field of cucumbers planted in an experimental way practically ruined as a result of nematodes; reported by J. Rosenbaum), Louisiana (prevalent, considerable loss), Ohio (commonly found in greenhouses; more prevalent than usual in the field; soil steaming gives good results), South Carolina (common; injury 30%, estimated loss 3%), Texas (traces, estimated loss 1%).

Injury from frost and drought were reported from Washington.

SQUASH

Bacterial wilt caused by Bacillus tracheiphilus E. F. S. was reported from California by D. G. Milbrath as present in small amounts in all parts of the state.

Downy mildew caused by Pseudoperonospora cubensis (B. & C.) Rostow was reported from New Jersey, where it caused slight loss.

Wilt caused by Fusarium sp. was prevalent in Texas, and local in California (Orange County).

Mosaic, cause undetermined, was reported from Pennsylvania on crook-neck squash, causing little aggregate injury to the crop, although it was very destructive to the plants attacked. The fruit on affected plants was hardly worth harvesting and was affected much as in the case of cucumbers with mosaic. It was also reported as very prevalent and causing considerable loss in Louisiana, and as severe in the Turlock section in California, causing a loss estimated at 25%.

WATERMELON

Anthracnose caused by Colletotrichum lagenarium (Pers.) E. & H.

Anthracnose was reported in 1919 from New Jersey, Delaware, Maryland, South Carolina, Georgia, Florida, West Virginia, Indiana, Michigan, Kentucky, Tennessee, Alabama, Louisiana, Texas, Oklahoma, Arkansas, and Kansas.

Dry weather in Indiana and Kansas, and hot weather in Louisiana prevented the occurrence of more than a trace of the disease in those states. The heaviest losses from anthracnose were reported from the Atlantic Coast States, as follows: Delaware, loss 10%; Maryland, loss 10-15%; South Carolina, injury

25%, loss 10%; Georgia, about 10% loss; Florida, loss considerable. In most of the other states reporting its presence the disease was local, except in Alabama, Texas where it caused a loss estimated at 2%, and Arkansas, where it caused 10% injury, affecting mostly the leaves.

Anthracnose was common in shipments of watermelons from various states. The following table shows the amounts of anthracnose reported by inspectors of the Bureau of Markets.

Table 82. Percentage of anthracnose caused by Colletotrichum lagenarium as shown by inspectors of cars at destination by inspectors of the Bureau of Markets, 1919.

Origin of shipment	No. of cars with decay	Average percentage of decay	Range of percentage of decay		Remarks as to seriousness of decay.
			No. cars	Percent	
Alabama	2	8	-	5-11	
Arkansas	1	3	-	3	
Delaware	3	37	2	1-10	Decay occurred in spots.
			1	100	Bad decay, affecting all melons.
Florida	40	35	25	2-25	Mostly spots.
			6	30-48	Bad decay in some cars.
			11	70-100	Stock practically worthless in some cars; in others one-half showed bad decay.
Georgia	102	27	63	1-25	Decay mostly in spots.
			25	28-50	
			14	55-100	Very bad decay.
Illinois	6	7	-	1-17	Mostly slight.
Indiana	3	13	-	4-30	Mostly in spots.
Maryland	4	5	-	2-10	Slight decay.
Missouri	7	37	4	2-25	Mostly slight decay.
			3	70-75	In advanced stages.
North Carolina	40	47	17	2-25	Mostly slight decay.
			9	30-55	
			14	72-100	Mostly advanced stages.
Ohio	1	2	-	2	Affecting appearance only.
Oklahoma	2	24	-	23-25	Affecting appearance only.
South Carolina	45	37	22	2-25	Mostly slight decay.
			12	30-50	
			11	60-100	In advanced stages.
Texas	25	13	20	2-25	Mostly slight spotting.
			3	30-45	
			2	65-100	Mostly in advanced stages.
Unknown	6	34	4	10-35	Affecting appearance only in some cars.
			2	50-75	Severe decay.

Total ... 287 Total number of cars inspected ... 584.

The following dates when the disease was first observed were reported by collaborators:

May 10 .... Georgia
May 27 .... Florida
June............... Arkansas
June 1........... South Carolina
July 24.......... Indiana
October 30....... Oklahoma

The use of Bordeaux gave good results in South Carolina and Florida.

Stem end rot caused by _Diplodia_ sp.

Stem end rot was reported as occurring in the field in Maryland, Tennessee, Louisiana, Iowa, Arizona (first report of this disease received by the Survey), and New Mexico. The loss caused was estimated at from 3-4 in Maryland, and about 1% in Arizona. From New Mexico the disease was reported as affecting as high as 15-20% of the melons in some places.

Stem end rot was more important on melons in transit. It was reported by inspectors of the Bureau of Markets as having been found in carloads from various states, as shown in the following table.

Table 83. Percentages of stem end rot caused by _Diplodia_ sp. as determined by inspectors of the Bureau of Markets, 1919.

Origin of shipment	No. of cars with decay	Average percentage of decay	Range of percentage of decay: No. of cars	Range of percentage of decay: Percent
Alabama	3	8	-	2-15
Arkansas	2	9	-	8-10
Florida	62	17	50	1-25
			8	27-40
			4	55-100
Georgia	156	19	129	1-25
			23	27-50
			4	55-100
North Carolina	15	9	-	2-25
Oklahoma	5	10	-	4-15
South Carolina	41	16	33	1-25
			6	35-45
			2	55-90
Texas	46	12	-	1-40
Unknown	7	13	6	1-15
			1	45

Total............337   Total number of cars inspected 584

Stem end rot was also found in watermelons consigned from Indiana, Illinois, Missouri, Ohio, and Wisconsin, but on account of the supposedly southern range of this disease it is possible that the melons may have been grown in other states, or perhaps, other organisms were concerned.

Blossom end rot, cause unknown.

Blossom end rot was reported from Delaware (2-4%, general), Indiana (common late in season, August 22), and Idaho (probably Fusarium sp., serious where reported; in Bonner, Latah, Nez Perce, and Elmore Counties).

Blossom end rot also caused some loss of melons in transit. It was reported by Bureau of Markets inspectors in carloads from the following states: Florida, 3 cars, 1-10%, average 4% decay; Georgia, 2 cars, 2-10%, average 6% decay; North Carolina, 1 car, 30% decay; South Carolina, 4 cars, 5-20% in 3 cars, 50% in 1 car, average 20% decay.

Wilt caused by Fusarium niveum E. F. S.

Fusarium wilt was reported in 1919 from Virginia, South Carolina, Georgia, Florida, Ohio, Indiana, Louisiana, Texas, Arizona, Kansas, and California.

In Virginia, South Carolina, Ohio, Louisiana, Kansas, and Arizona the disease was not important. In Florida it was common, causing injury ranging from 1-3%. In Georgia it was also generally prevalent, causing injury as high as 30%, resulting in a loss estimated at from 5-6%. Weather conditions in Georgia favored the disease, as also in Texas, where a loss of 8% was reported. In California, according to D. G. Milbrath, the disease was severe in the vicinity of Turlock in the San Joaquin Valley. In Indiana Fusarium wilt was reported to have become the limiting factor in the watermelon industry, not only making long time rotations necessary, but preventing the growing of watermelons in some sections.

Dates when the disease first appeared were reported by collaborators as follows:

April 20	Florida	July 23	Virginia
July 1	Georgia	August 18	Ohio

Control measures reported as used in Florida were seed and field sanitation and crop rotation.

Other diseases.

Alternaria leaf spot caused by Alternaria sp. was reported from Ohio, and from Indiana where it was common but caused no particular loss.

Leaf rot caused by Cercospora citrullina Cke. was reported from Texas as prevalent and causing a loss estimated at 2%.

Bacterial wilt caused by Bacillus tracheiphilus E. F. S. was said to be local in South Carolina.

Stem rot caused by Mycosphaerella citrullina (C. O. Sm.) Gros. occurred in Florida, where it first appeared April 18, and was said to be fairly common. It was also reported from Louisiana, where it was occasional and caused slight loss. Control measures recommended in Florida were seed disinfection and spraying with Bordeaux.

Stem rot caused by Sclerotinia libertiana Fckl. was said to be common in New Jersey, probably due to wet weather.

Southern blight caused by *Sclerotium rolfsii* Sacc. was local in South Carolina.

Stem rot caused by *Rhizoctonia* sp. was said to have caused considerable injury in some sections of Louisiana. It was first observed in June.

Root knot caused by *Heterodera radicicola* (Greef.) Müll. was reported from South Carolina as common, causing 50% injury to the crop, and a loss estimated at 5%. It was also reported from California, where it was severe in the vicinity of Turlock, according to D. G. Milbrath.

Stem-end rot due to adverse weather and soil conditions was common in Florida, causing injury which was probably not over 1%. Proper cultivation to conserve moisture in the soil was suggested as a method of control.

DISEASES OF MISCELLANEOUS CROPS

ARTICHOKE (Globe)

Botrytis sp. was reported by D. G. Milbrath as occurring on overmature and stunted heads in the Half Moon Bay section of California.

ARTICHOKE (Jerusalem)

Mildew caused by *Plasmopara halstedii* Earl. was reported from Vermont, where it caused small loss.

ASPARAGUS

Rust caused by *Puccinia asparagi* DC.

Rust was reported from at least twenty widely scattered states, particularly in the northern and central portions of the country. For the most part it occurred in about the usual amounts, but was said to be less prevalent than usual in Vermont, Ohio, and Georgia. In the last-named state asparagus beds heavily infested in 1918 were practically free from rust in 1919. In most states distribution was local and the aggregate losses slight. In Vermont, however, 25% injury to the crop caused a loss estimated at 5-10%, and in South Carolina 80% injury probably resulted in a loss of 5%.

The following dates when the disease was first noticed were reported:

June 3	Minnesota	August 22	Pennsylvania
June 13	Colorado	August	South Carolina
July	Wisconsin	October 1	Vermont

Varieties reported resistant were U. S. Government rust resistant seedling in Connecticut, and Palmetto, Washington, and Giant Argenteuil in South Carolina. However, the last-named variety was reported subject to rust in Connecticut.

Other diseases.

Dwarfing and malformation of new shoots, associated with Fusarium sp., was reported from New Jersey. The Fusarium was said to be always present, but it has not been proven to be the cause of the disease.

Stem rot caused by Fusarium sp. was reported from Ramsey County, Minnesota, September 11.

Fusarium sp., causing red streaks on shoots, was reported as slight on 10% of the crop in the Delta section of California.

Anthracnose caused by Colletotrichum sp. was rather severe on Burr's Mammoth in wet places in New Haven County, Connecticut. This was said to be the first report of the appearance of the disease in the state.

BEET (Garden and sugar).

Scab caused by Actinomyces scabies (Thax.) Güssow was reported from Vermont, Connecticut, New Jersey, Pennsylvania, West Virginia, and Minnesota. It caused appreciable loss only in New Jersey, where it was said to be very severe and destructive locally in the northern part of the state.

Crown rot caused by Phoma betae Frank was reported from New Mexico, where it caused a loss estimated at 1%. The Phoma leaf spot and crown rot were reported by collaborators as occurring on sugar beets in Colorado and Idaho, causing slight losses in both states. The disease was also found on specimens received by the Office of Sugar Plant Investigations from the following additional states: Virginia, Wisconsin, Kansas, and California.

Leaf blight caused by Cercospora beticola Sacc. was reported as generally prevalent but causing slight losses in Vermont, New Jersey, South Carolina, Georgia, Ohio, Indiana, Minnesota, Missouri, and Texas. It was local in Connecticut, Kentucky, North Dakota, and Oklahoma. On sugar beets the disease was abundant in Colorado, and in California, where it caused moderate losses. In Indiana, Iowa, and Idaho it occurred locally. It was reported by the Office of Sugar Plant Investigations as having been found on specimens from Virginia and Nebraska also.

Stem rot caused by Sclerotium rolfsii Sacc. was reported from Spaulding County, Georgia.

Rhizoctonia (Corticium vagum solani Burt.) was reported from Snohomish and Wahkiakuh Counties, Washington.

Crown gall caused by Bacterium tumefaciens E. F. S. and Townsend was reported as causing very little damage in Polk County, Wisconsin.

Root-knot (Heterodera radicicola (Greef.) Müll.) was reported from Mississippi and Texas as unimportant, although prevalent in the latter state. It occurred in sugar beets in Colorado, where it caused a loss of less than 1%; and in southern California, where it was severe, according to D. G. Milbrath.

The sugar beet nematode (Heterodera schachtii Schmidt) was reported from Colorado and California. D. G. Milbrath reported that in Southern California it caused heavy losses, reducing the yield in one section of Orange County from 15 tons (the normal yield) to 1.5 tons per acre and the sugar content from 15-16% to 11-12%. Soil infestation in that locality was said to be increasing.

Crop rotation and soil treatment were recommended from Colorado as control measures for both nematodes, although the former method was said to give only fair results, and the latter was commercially impracticable.

Curly top or mosaic, cause not definitely determined, was reported from Dona Ana County, New Mexico. It was reported on sugar beets from Idaho, where it was said to be prevalent, causing a loss estimated at 20%; from Colorado, especially in the Arkansas Valley; from Walla Walla County, Washington; and from the San Joaquin Valley, California, by D. G. Milbrath, where it was unusually severe, causing an almost total loss. It was found also in specimens received by the Office of Sugar Plant Investigations from Utah, and Kansas.

A bacterial heart rot of mangel-wurzels was reported from Pierce County, Washington.

Sugar beets examined at the Office of Sugar Plant Investigations showed the following diseases:

Fusarium spp., Kansas, Michigan, Utah, and Idaho on roots; Colorado on leaves; Virginia on roots and leaves.

Leaf spot caused by Alternaria sp., - Virginia, Michigan, Utah, Colorado, Idaho, and California.

Rheosporangium aphanidermatus Edson - Utah.

Rhizopus nigricans Ehr., - Utah and Idaho.

Diplodia sp., - Colorado.

Penicillium sp., (secondary) - North Carolina, Idaho, Colorado.

Mucor sp., - Utah.

"Purple leaf disease", - a disease of unknown cause reported from Idaho, from Utah; apparently of bacterial nature, but cultures failed to show anything but saprophytic bacteria.

CARROT

Root knot caused by Heterodera radicicola (Greef.) Müll. was reported to be common in South Carolina, injuring a large percentage of the crop.

Leaf spot caused by Cercospora apii Fr. occurred locally in Indiana, but caused no loss.

Rhizoctonia was reported as abundant from Klickitat County, Washington, August 1; and from Porto Rico in the vicinity of San Juan, attacking the foliage only, and causing 70% injury to the crop.

Rot caused by Sclerotium rolfsii Sacc. was reported to be rather abundant locally in Oconee County, South Carolina.

Watery soft rot caused by Sclerotinia libertiana Fckl. was common on the 1918 crop in storage in Tippecanoe County, Indiana.

Soft rot caused by Bacillus carotovorus Jones was reported from Kentucky and Oklahoma.

A *storage rot* caused by *Penicillium* sp. was reported February 22 from Whitman County, Washington.

A *storage rot* caused by *Botrytis* sp. was reported February 22 from Whitman County, Washington.

A *brown rot*, cause not determined, was reported July 14 to be causing severe damage locally in Jasper County, Missouri.

Soft rot, cause unknown, was reported from Long Beach, Mississippi, where in one field less than 5% of the plants were affected. A similar trouble was abundant in Gooding and Twin Falls Counties, Idaho.

CASSAVA or Tapioca (Manihot utilissima)

Root rot caused by *Phytophthora* sp. and *Rhizoctonia solani* occurred in Porto Rico. Only one case was reported.

CELERY

Late blight caused by *Septoria petroselini apii* Br. and Cav.

Late blight seemed to be not so widely distributed as in 1918. It was reported from Massachusetts, Connecticut, New Jersey, Pennsylvania, Florida, Ohio, Indiana, Michigan, Missouri, Arkansas, North Dakota, Colorado, and California. In 1918 it was reported also from New Hampshire, New York, Virginia, South Carolina, Texas, Illinois, Wisconsin, Montana, Utah, and Washington.

The disease was more abundant than usual in Connecticut, although appearing late in the season; while in Ohio it was more generally distributed but caused less damage than usual. In Florida, Ohio, Indiana, Michigan, Missouri, Arkansas, and North Dakota the disease was apparently not especially important. In Massachusetts and New Jersey it was reported to be severe and generally prevalent, in the former state causing losses often amounting to 50% in unsprayed fields. In Pennsylvania the loss was estimated at 5%. In Colorado the disease was common, particularly in the vicinity of Denver, causing probably 25% injury to the crop and 2% loss. The largest losses due to late blight were reported from California by D. G. Milbrath. In the southern part of that state the loss was estimated at 8%, although continuous spraying was practiced, and in the Watsonville section the crop was considered a failure and shipments abandoned because of a 40% loss.

Late blight was found by inspectors of the Bureau of Markets in celery shipped to eastern and middle-western markets from California, Colorado, Florida, Michigan, and New York, as shown in Table 84.

Dates when the disease was first noticed were reported by collaborators as follows:

August 6 .... Missouri
September 1 ...... Colorado
September 6 .... Indiana
September .... Pennsylvania

Excellent results from the use of Bordeaux mixture in controlling the disease were reported from Massachusetts and New Jersey. In Pennsylvania it was said that the disease was much more severe in fields in which crop rotation was not practiced.

Table 84. Prevalence of late blight of celery in cars examined by inspectors of the Bureau of Markets, 1919.

Origin of shipment	No. of cars	Date inspected	% affected plants	Remarks as to severity of late blight.
California	1	Apr. 1	20-25	Damage beginning to affect tops of branches.
	1	Apr. 8	-	In two top layers.
	1	"	-	Decay in top leaves general, consisting of bad late blight and soft rot.
Colorado	1	Sept. 25	35	
Florida	1	May 9	Slight-100	All top leaves in upper crates badly affected, 60% in middle layers and a mere sprinkling in lower part.
	1	May 9-10	100	Entire stock badly spotted with late blight.
	1	May 23	Slight	Slight decay, a few scattering leaves showed decay following late blight.
Michigan	1	Oct. 31	-	Slimy soft rot following late blight in leaves and upper branches of all stock; into 1-2 main branches in about half of stalks.
	1	Nov. 4	-	Decay in leaves and top branches throughout load.
New York	2	Nov. 3	-	Slimy soft rot following late blight throughout load in both cars.

Early blight caused by Cercospora apii Fr.

Early blight was reported from most of the northeastern states, and from South Carolina, Florida, Missouri, and California. In most states it occurred in about the usual amounts, but in Massachusetts, although abundant in certain localities, it was not so generally distributed as in 1918, and in Ohio also it was said to be less prevalent. Pennsylvania, on the other hand, reported more than in 1918.

Injury from early blight seemed to be local for the most part and losses were not particularly important in most cases. In Vermont, however, the loss was estimated at 2-5%, and in Pennsylvania at 2%. In southern California the disease was especially severe and caused a loss of 10%, according to D. G. Milbrath.

Examinations made by inspectors of the Bureau of Markets at Chicago and other middle-western cities showed varying amounts of early blight on celery from Florida, Louisiana, and New York. The findings in individual cars are given in the following table:

Table 85. Prevalence of early blight of celery in cars examined by inspectors of the Bureau of Markets, 1919.

State	Date	% affected plants in individual cars	Abundance of early blight lesions
Florida	May 9	100	Numerous.
	" -	-	"
	" -	-	Few, scattered.
	" 14	100	Many.
	" 15	-	Few, scattered (25-75% secondary decay).
	" 17	About 100	Slight.
	June 6	" 40	--
	June 25	-	Some
	" 25	-	"
Louisiana	June 20	Probably 100	Very numerous.
	" 26	100	Heavy infection.
New York	Nov. 7	About 100	8-10% affected leaves.

Dates when the disease was first noticed were reported by collaborators as follows:

July 14	Missouri	October 1	Vermont
July 22	Indiana	October 24	Pennsylvania

Spraying with Bordeaux mixture was said to give excellent results in controlling the disease in New Jersey.

Foot rot caused by *Sclerotinia libertiana* Fckl.

This disease was reported as occurring in the field from New Jersey and from Florida. In New Jersey it was said to be only occasionally found; but in Florida it was abundant, although probably not doing so much damage as in the preceding year.

Watery soft rot, as the disease is called in the market, was prevalent throughout the year in car lots of celery shipped from the following states: California, 14 cars, loss ranging from a trace to severe, mostly considerable;

Colorado, 2 cars, average loss slight; Florida, 36 cars, loss ranging from a trace to very severe, average probably rather severe; Louisiana, 1 car with considerable loss; Michigan, 6 cars, considerable; New York, 11 cars, loss slight to considerable, mostly considerable; Utah, 1 car, loss considerable.

The damage in individual cars was sometimes particularly severe. Some of the heaviest losses were reported as follows: In one car of California celery, "All stalks in 14 crates in top of load, 25-30% of stalks in upper layer, 20-35% of stalks in second layer, 15-20% of stalks in bottom tier affecting 2 to 6 branches. Decay in tops general throughout load consisting of late blight and watery soft rot."

In Florida celery, Car No. 1 showed "lower tiers 5-10% bad decay; next to top tier 75%; top tier 90-95%, all of this bad decay." Car No. 2 showed "100% of stalks in top tiers of crates, 75% in second tier, and 50% in rest of tiers with watery soft rot, in lower part of tiers slight, in upper part mostly complete decay."

In one car of New York celery, "Most stalks in all crates showed decay. From one-fourth to three-fourths of the bunches were almost completely decayed, due to watery soft rot."

As may be seen from the reports quoted above, the decay was usually most severe in the upper tiers. It was also often mentioned as being bad near the doorways.

Other diseases.

A bacterial crown and heart rot was said to be very severe and destructive in some localities in New Jersey, and was also reported from Indiana, where it was prevented from becoming serious by unfavorable dry weather.

A bacterial leaf spot was reported from Indiana, where it was said to be common, and from Michigan. In the latter state it was observed by R. Nelson as "Taking the form of petiole lesions, causing great loss in fields about Kalamazoo since the blighted portions rot badly. Growers assign trouble to frost."

Black heart in 1919 was reported only from Florida. G. K. K. Link, who visited the Sanford, Bradentown, and Manatee districts in the early part of March, reported as follows:

> "More serious from a market point of view than the early blight is the very general appearance of heart rot which was induced prematurely by the heavy rains. Usually heart rot is found later in the season in Golden Heart celery...... It is least marked on the muck lands near Bradentown. The dead tissue is at first light brown and quite watery in appearance, much as tip burn affected lettuce appears. Very soon bacteria attack the killed tissues and cause a black rot. I saw acres of fields in which the hearts had rotted away completely."

"Stunt" or yellows was reported to the Survey in 1919 for the first time. The disease occurred in Indiana and Michigan. In Indiana, where it was first reported July 8, it caused 10% injury in certain cases. In this state the variety Golden Self Blanching was said to be susceptible, while Easy Bleaching and all late varieties were found to be resistant. In Michigan the disease was found July 1 at Mason, where seed-bed infection led to severe injury of the entire celery planting.

Root rot caused by Phoma apiicola Speg. was found in Michigan. C. W. Bennett reported that this root rot had in several instances done considerable damage to celery in the past few years. (Phytopath. 10: 67, 1920.)

Rhizoctonia was found in negligible amounts in Connecticut, Ohio, and Colorado.

Root knot caused by Heterodera radicicola (Greef.) Müll. was reported by D. G. Milbrath as severe in southern California, causing a loss of 2%.

So-called rust, supposedly non-parasitic, was reported November 10 from two farms in Indiana County, Pennsylvania, where losses of 50% and 75% on the variety White Plume occurred.

A condition spoken of as "heart blasting", cause unknown, was reported from California by D. G. Milbrath, who described it as affecting the heart, leaving only an outer circle of leaves. Five per cent occurred in the Delta region, and two per cent in Southern California.

EGGPLANT

Fruit rot caused by Phomopsis vexans (Sacc. & Syd.) Harter.

In 1919 fruit rot was reported from fewer states than in 1918. It was reported to the Survey from South Carolina and California for the first time, and from New Jersey, Florida, Ohio, Indiana, Iowa, Missouri, Louisiana, and Oklahoma.

In Ohio, Louisiana, and Missouri the disease was reported as causing slight damage. In South Carolina, Indiana, and Iowa it was said to be abundant locally, particularly in the latter state, where, in two cases, the crop was almost completely ruined. In New Jersey it was reported as abundant and in some instances very destructive. In Florida and in California the heaviest losses from fruit rot apparently occurred. As much as 90% of the crop was said to be injured in some localities in the former state. G. K. K. Link reported in March that in the vicinity of Fort Myers, one of the largest eggplant growing sections of the state, whole fields were completely ruined by the disease, and losses were so heavy that growers were about to give up the culture of eggplant. Reports of inspectors of the Bureau of Markets showed fruit rot also severe on Florida eggplant in transportation (7 cars). In California D. G. Milbrath reported that the disease caused 60% loss in San Diego County, the only section of the state where eggplant was grown on a commercial scale.

No variety was reported as being either especially resistant or susceptible. The use of disease-free seed, crop rotation, and the disease-free soil in seed beds was recommended in Florida as a means of controlling fruit rot.

Bacterial wilt caused by Bacterium solanacearum E. F. S.

In 1919 bacterial wilt was reported only from South Carolina and from Florida. In both states it was local in distribution and was not reported as particularly important. In Florida crop rotation was apparently successful in controlling the disease.

Verticillium wilt caused by Verticillium sp.

This wilt was reported as local in South Carolina, and as generally prevalent and destructive in both New Jersey and Georgia. In the latter state it was said to cause damage ranging up to 50% of the crop in some cases.

Other diseases.

Root knot caused by Heterodera radicicola (Greef.) Müll. was reported to be generally prevalent in South Carolina, where 45% injury to the crop resulted in a loss estimated at 3%; and in Florida, where it was common on the lighter soils. Crop rotation was recommended in the latter state as a method of controlling the disease.

Southern blight caused by Sclerotium rolfsii Sacc. was reported as general in Georgia, causing injury ranging from 1-50%.

Fusarium wilt caused by Fusarium sp. was reported from Florida, where it was said to be local and unimportant.

Anthracnose caused by Gloeosporium melongenae Ell. & Hal. was reported as causing slight loss, 1% or less, in Delaware.

Rhizoctonia was reported from Louisiana as causing slight injury in seed beds.

Mosaic was reported by C. D. Sherbakoff from Palm Beach County, Florida.

A wilt, cause not determined, was said to be serious in market garden sections around Indianapolis, causing 50% injury. An undetermined wilt was also reported from Missouri, where it was not important.

GARLIC

Botrytis sp. was reported by D. G. Milbrath from Alameda County, California, as slight on garlic in the field, but increasing rapidly in storage.

GINSENG

Blight caused by Alternaria panax Whetzel was reported from Iowa (common, estimated loss severe), and from Minnesota.

Rhizoctonia sp. was reported from Washington (King County).

HORSE BEAN (Vicia faba)

Rust, caused by Uromyces sp., was reported from Louisiana as common, affecting a majority of the plants and causing a considerable loss to the crop as a whole.

Sun scald was reported from Northern Idaho.

LETTUCE

Drop caused by Sclerotinia libertiana Fckl.

Drop again seemed to be the most serious disease of lettuce, although fewer reports were received than in 1918. It was reported from most of the eastern and southern states and from California. Traces were reported from North Carolina and Mississippi, and it was said to cause slight losses in South Carolina, Michigan, Alabama, and Colorado. In the other states it caused considerable injury and loss, particularly in Pennsylvania (in the vicinity of Philadelphia), Florida, and California in the field; and in Massachusetts, New Jersey and Indiana in greenhouses and cold frames.

Considerable loss was caused by this disease in the markets, where it is known as watery soft rot. These losses as estimated by inspectors of the Bureau of Markets are shown in the following table:

Table 86. Losses caused by watery soft rot of lettuce as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	No. of cars with decay	Average percentage of decay	Range of percentage of decay		Remarks as to seriousness of decay.
			No. cars	Percent	
California	5	24	3	5-15	Slight decay.
			2	35-60	Bad decay.
Florida	10	59	2	12-20	Slight decay.
			4	42-63	Bad decay.
			4	75-100	Worthless.
New York	2	58	1	30	
			1	85	Bad decay.
Pennsylvania	1	22	1	5-40	
South Carolina	1	75	1	75	Following tip burn.
Texas	4	74	1	45-100	Bad decay.
Unknown	1	-	1		Bad decay, affecting 3-20%.

Gray mold rot caused by Botrytis cinerea Pers.

Gray mold rot was reported from Massachusetts, New York, Pennsylvania, North Carolina, Ohio, Indiana, Michigan, Wisconsin, Iowa, Louisiana, Texas, Oklahoma, Arkansas, and Washington. In 1918 it was reported only from Massachusetts, New York, Pennsylvania, Arkansas, and Ohio.

The disease was said to be unimportant or occasional in New York, Ohio, Michigan, Wisconsin, Louisiana, and Oklahoma. It was reported as very abundant in greenhouses in Massachusetts, probably favored by cloudy weather, and in

Indiana, where it was said to be the most serious greenhouse disease of lettuce. In Pennsylvania, although reported to be less abundant than in 1918, it was generally prevalent wherever lettuce was grown, causing a loss estimated at 2-3%. In Texas it was said to be prevalent, perhaps because of wet weather, causing a loss estimated at about 1%. From North Carolina it was reported by R. A. Jehle as follows:

> "I spent Monday in New Hanover County, going in response to a telegram from the county agent. He took me to a number of fields and I found head rot in every field visited. Losses were from one-third to over-one-half of crop. The county agent estimated that the loss in the county will average about one-third of crop. The trouble seems to be caused by Botrytis cinerea which I found fruiting in many beds. The disease begins at the tips of the leaves, causing them to turn yellow, then brown, and finally a slimy rot follows. Heads may look healthy but when opened the tips of inner leaves may be infected. As prevalent on one variety as another and found on plants grown on different types of soil."

Downy mildew caused by Bremia lactucae Regel.

Downy mildew was reported as causing slight losses, usually in greenhouse, in most of the northeastern states. In Ohio and in Indiana it was said to be generally severe in early spring, in the latter state causing 80% injury to lettuce in some greenhouses. Traces were reported from Iowa and North Dakota. The disease was also found in Texas, where it was said to be rather abundant in the field in some sections.

Reduction in the amount of water given, good ventilation, and three applications of Bordeaux mixture were said to be effective in controlling the disease in greenhouses in Iowa.

Stem rot and rosette caused by Rhizoctonia sp.

Rhizoctonia occurred in the northeastern states, in Louisiana, Texas, and Oklahoma, in North Dakota, and in Washington. In most cases the losses caused by it were said to be slight or very slight. In some states, however, it did considerable damage. In New York, where it was said to be more severe in the western part of the state, the losses in greenhouse lettuce were estimated at 10%, and in the field as ranging from 5-50%. In Ohio it was reported as more severe on poorly drained clay than on other types of soil. In Pennsylvania it was said to be very severe, as usual, causing losses estimated at from 3-5%. A loss of 1% was reported from Texas.

Control measures were reported only from Ohio, where steam sterilization of soil in greenhouses was said to give good results.

Tip burn (non-parasitic)

In 1919 tip burn was reported from South Carolina, Florida, Louisiana, Texas, and California. Only one of these states, Louisiana, reported the disease as present in 1918, when it was also found in Massachusetts and Pennsylvania.

In Texas the disease was reported by L. R. Hesler as causing moderate damage and slight loss in one large field near Harlingen. In South Carolina, where it was common near the coast, it was said to cause 20% injury, resulting in a loss estimated at 2%. In Florida it was reported by G. K. K. Link as very abundant, causing fields to be abandoned in one locality. In Louisiana, according to L. R. Hesler, it was the most prevalent lettuce trouble in the region south of New Orleans. In California it was reported by D. G. Milbrath to be common in all sections.

The disease was also found affecting lettuce in transportation from some of these states and from several additional states. Losses caused by it are shown in the following table:

Table 87. Losses caused by tip burn of lettuce as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	No. of cars with tip burn	Average percentage of tip burn	Range of percentage of tip burn		Remarks as to seriousness of disease.
			No. cars	Percent	
California	11	44	4	2-9	Slight decay.
			3	32-50	
			4	65-100	Bad decay.
Illinois	1	-	1		Heavy tip burn.
Minnesota	1	30	1	20-40	Accompanied by slimy soft rot.
New York	6	32	2	2-10	Slight decay.
			4	50	Followed by slimy soft rot.
North Carolina	1	-			Outer leaves of many heads.
South Carolina	1	100	1	100	All heads affected.
Texas	2	47	1	20	Affecting several outer leaves.
			1	75	Bad decay.

Other diseases.

Wilt caused by Fusarium sp. was reported from Ohio.

Leaf spot caused by Alternaria sp. was reported from Louisiana.

Leaf spot caused by Cercospora sp. was reported from Louisiana as causing slight loss.

A leaf spot due perhaps to Ramularia sp. was reported by D. G. Milbrath as general in the vicinity of San Francisco.

Slimy soft rot caused by bacteria of the Bacillus carotovorus type was reported injuring the crop in the field in Minnesota, Louisiana, and California. In Louisiana it was associated with tip burn and caused a loss estimated at 5-10%. This combination of injuries was said to constitute probably the most serious lettuce trouble in the state. Slimy soft rot was also very common and caused heavy losses in shipments of lettuce to various markets.

Bacterial rots caused by *Bacterium marginale* and *Bacterium vitians* were reported from New Jersey. *Bacterial blight* due to the latter organism was reported as common in the coast region of South Carolina, causing a loss of 5%.

Root knot due to *Heterodera radicicola* (Greef.) Müll. was reported from South Carolina as common, causing a loss estimated at 5%, and from Ohio as more prevalent than usual.

Bacterial leaf spots were reported from Florida, Ohio, and Indiana.

Internal browning, cause unknown, was reported by D. G. Milbrath as severe in the Imperial Valley, California, causing the abandonment of several fields. He describes the disease as follows:

> "It appears to be a definite disease causing internal browning from the crown (inclusive) upward. The outer leaves of the head are apparently sound with the exception of marginal browning, readily judged the result of dryness or injury by soil contact. The second cycle of leaves usually is normal. Under this cycle the browning increases into the heart."

LIMA BEAN

Downy mildew caused by *Phytophthora phaseoli* Thax.

Downy mildew was reported from Connecticut, New Jersey, Delaware, Pennsylvania, and California. In the first four states mentioned the disease was considerably more abundant than usual. In a number of localities high losses were recorded. For instance, one large grower in Connecticut reported 75% of his crop destroyed, and in Pennsylvania 75% of the lima beans at Bustleton were affected. The weather conditions were apparently very favorable for the disease so that it spread rapidly and was destructive to susceptible varieties.

Other diseases.

Pod blight caused by *Diaporthe phaseolorum* (C. & E.) Sacc. was reported from Connecticut (scarce), New Jersey (prevalent but not destructive in the southern part of the state), Alabama (general), and Louisiana (general, at least in St. Landry Parish).

Rust caused by *Uromyces appendiculatus* (Pers.) Lev., was reported by E. V. Hollis from Louisiana where he found a slight amount locally; and by D. G. Milbrath from California, where it was present but not causing very high losses, although the variety Lady Washington was rather severely affected in the southern part of the state. This disease on lima bean was thought not to be a very common thing in Louisiana.

Bacterial blight, thought to be caused by *Bacterium phaseoli* E. F. S. was reported from Pennsylvania, South Carolina, and Louisiana. In Pennsylvania C. R. Orton reported as follows: "Brown fibro-vascular bundles, plants typically wilted. Only seen on the pole limas; bush limas in adjacent rows not affected. Have not seen this disease before in the state." It was first noticed by Orton September 21 in Lycoming County.

In South Carolina the disease was said to be common and generally destructive, injuring a rather large proportion of the crop.

Mosaic (cause undetermined) was reported by D. G. Milbrath from California as severe in parts of Los Angeles County.

Root rots, caused by Fusarium and Rhizoctonia spp., were troublesome in Orange, Los Angeles, and San Diego Counties, California. The lima bean crop in Southern California was short last year. While much of this was attributed to lack of moisture, it was thought by Milbrath that Fusarium and Rhizoctonia were responsible for a large amount of the reduction in yield by attacking the roots and stems.

Root knot caused by Heterodera radicicola (Greef.) Müll. was severe in Los Angeles and Orange Counties in California, where 10% loss occurred, according to estimates of D. G. Milbrath.

Powdery mildew caused by Erysiphe polygoni DC. caused a 2% loss along the coast in California.

OKRA

Verticillium wilt caused by Verticillium albo-atrum R. & B. was reported as abundant in one locality in New Jersey.

Root rot caused by Ozonium omnivorum Shear was prevalent in Texas, causing a loss estimated at 4%.

Root knot caused by Heterodera radicicola (Greef.) Müll. was reported as causing 5% loss in South Carolina, and slight loss in Louisiana.

PARSNIP

Leaf blight caused by Cercospora apii pastinaceae occurred in Connecticut, where it was said to be more prominent than usual, although not serious.

PEA

Blight caused by Mycosphaerella pinodes Berk. & Blox.
= Ascochyta pisi Lib.

In 1919 this blight was reported from New Jersey, Delaware, Pennsylvania, Maryland, Georgia, Ohio, Indiana, Wisconsin, Minnesota, Mississippi, Louisiana, Texas, Arkansas, and California. The disease was apparently not serious in most states. In Maryland, however, it reduced the crop considerably, and in California it was reported very severe in the region around San Francisco Bay, particularly on early peas. In Wisconsin there was less blight than usual. The campaign conducted in that state since 1912 on the value of crop rotation, clean seed, and cultivation was thought to be largely responsible.

Bacterial blight caused by Bacterium pisi Sackett.

Reported from Colorado (scarce, slight injury) and Michigan (common with certain lots of seed, loss slight).

Bacterial blights (causes uncertain).

Blights of a bacterial nature were reported from Delaware, Maryland, District of Columbia, Mississippi, Louisiana, Indiana, and Wisconsin. In Delaware the trouble was ascribed to Bacterium lathyri by Manns. The disease was the cause of large losses in some of the canning sections of the East. The following report on the situation in Delaware is supplied by T. F. Manns:

Pea situation in Delaware
by
T. F. Manns.

The almost general collapse of peas has caused much alarm among farmers and canners as to the future of the pea crop. From what all thought to be an ideal pea season, that is, cool, wet weather, there has resulted a crop close to a failure. May, with a rainfall of nearly five inches, proved a disastrous month for the crop.

Opinions among the more successful growers vary widely. Many hold that the unusually early and severe green lice attack was responsible, with wind and sand storms contributing causes; others that rains were excessive and too frequent and aside from the earliness of the lice attack and the wind and sand injury, the season was somehow or somewhat responsible. Some have blamed the fertilizer and others, having their first experience with agricultural salt, felt this new venture was their downfall.

After a careful survey of the whole district, it is estimated that the crop will not reach 25% of a fair yield. Many fields will not be cut.

Certain specific pea diseases are responsible for the failure on the well prepared and manured fields. The soils in many fields have become pea sick. One of these troubles; namely, a bacterial disease, has been greatly aggravated and spread by the green lice as carriers of the trouble, after their mouth parts became infected. The disease starts as a sick soil condition and spreads by rain spattering the germs on the plants. Severe winds and blowing sand have been contributing factors. The many wet days and nearly five inches of rainfall in May have not only assisted in spreading disease but on the weaker soils have leached out so much of the nitrogen as to cause very weak growth.

In the survey of the pea district made by the Department of Plant Pathology, these troubles were common throughout the district. Some fine fields were found and the history of every good field showed that peas had not been grown on the land from four to six, eight, and ten years, and even in some cases never before in the memory of the owner. The fact that many good fields were found would set aside the possibility that the season was entirely abnormal, or that wind and rains were entirely responsible, for all received the heavy and frequent May rains and other seasonal conditions; and many of the good fields were exposed to strong winds and sand movement. Also practically all fields had an early and quite general distribution of lice. The non-sick fields continued normal and made rapid growth, quickly outgrowing the lice. This was not the case of the sick lands; the lice early became contaminated with the disease, and abundantly infected the plants at the base of the stem. Wind and rains were contributing factors on sick soils. On some new fields, with weak soils upon which 400 to 500 pounds of 2-10 fertilizer only were used, collapse from starvation was the chief factor. However, growers have learned that peas cannot be grown on run down lands by use of low grade fertilizers only. Unless land is in good condition manure must be used. Inoculation on all good fields was well supplied though some growers claimed not to have used soil or cultures in getting such good results.

In many fields examined, none in peas the second season in succession showed good results and those fields which were in for a third or fourth season were practically failures, regardless of how well the land was prepared, fertilized, manured, or when planted. On such sick fields early seeding was equally disastrous with late seeding. On well rotated and properly fed lands with peas this season for the first time in four to six years, they had in nearly every case a good crop, with little sickness showing, though enough was present to indicate rotation should be practiced.

Root rots caused by various organisms.

The pea root rot and blight problem is a complicated one and is serious at least in some sections of the country, especially in certain canning sections. Apparently there are a number of parasites concerned. The bacterial troubles just described are factors, Fusarium is believed to be important, and Rhizoctonia, Pythium and possibly other fungi may be involved.

Root rots thought to be caused by Fusaria were reported as local in Michigan, Mississippi, and California (Alameda County), and as apparently less general and less severe than usual in Ohio. In New York root rot was said to be as a rule not serious in larger fields, but very common in gardens, where crop rotation was not usually practiced. Georgia, Alabama, and Colorado also reported it present in home gardens. In Pennsylvania Fusarium was said to be serious, but probably confused with Rhizoctonia, which was also abundant. In Maryland it was reported to be increasing in prevalence and severity each year, causing much reduced yields. The disease was abundant and destructive in Massachusetts, New Jersey, and Delaware; in Wisconsin, where the injury due to it was difficult to estimate, being combined with hot weather injury; and in Louisiana, where it killed the plants before they commenced bearing.

The following special reports from Maine and Maryland are of especial interest:

> Maine: (W. J. Morse) "We have had numerous complaints of a basal stem-rot of pea this season, but not as many as in certain wet seasons. We have no conclusive evidence but think this is, as a rule, caused by a Fusarium. From conversation with

> Temple of Maryland, Cook of New Jersey, and Richards of Wisconsin at the recent meeting on Long Island I am inclined to think that our trouble is about the same as they have there."

Maryland: (C. E. Temple) "Becoming more serious each year. The disease has spread throughout the canning section and into almost all gardens. It does not cause total loss but a much reduced yield. First year's work in selecting wilt-resistant plants has been very promising of results. A few hundred plants out of several thousand have stood the test two years in succession."

Rhizoctonia root rot was reported from Pennsylvania, where it was serious in a number of instances, and from Washington.

Pythium root rot occurred in Connecticut, Illinois, Michigan, and Wisconsin. Regarding its occurrence in the former state G. P. Clinton stated;

> "Unusual and serious trouble this year, saw two fields with less than one-half of a crop and several complaints from over the state have been received. Plants showed red root rot but could not always find Pythium, think this becomes obscured by the other things."

In Wisconsin, Michigan, and Illinois Pythium seemed to be the chief causal factor in the prevalent pea root rot trouble of those states according to F. R. Jones (Phytopath. 10; 67, 1920.)

Septoria blight caused by Septoria pisi West.

Septoria blight was reported from Ohio, Wisconsin, Texas, and California. It was not important except in California where it was severe in Alameda and Santa Clara Counties, according to D. G. Milbrath.

Mildew caused by Erysiphe polygoni DC.

Mildew was found in Vermont, New York, Pennsylvania, Ohio, Wisconsin, Minnesota, Georgia, Alabama, Louisiana, Texas, Oklahoma, Colorado, Idaho, and California. Although common in many states, it in most cases appeared too late to cause much injury to the crop. In Colorado and California, (San Diego County) however, it was locally very severe, causing 100% injury in the former state. According to D. G. Milbrath, sulphuring was practiced in California to control the disease.

Other diseases and injuries, 1919

Pod rot caused by Phytophthora terrestria Sherb. was reported by Matz from Porto Rico as having been found in 1919 for the first time. The injury caused was small.

Downy mildew, caused by Peronospora viciae Berk. was local in Wisconsin, loss trace.

Rust caused by Uromyces pisi (Pers.) De Bary was reported from North Dakota.

Root knot caused by Heterodera radicicola (Greef.) Müll. was reported by D. G. Milbrath as present in the Imperial Valley, California.

Leaf scorch was reported from Livingston County, New York.

Frost injury was reported from Pierce and Whitman Counties, Washington.

PEANUT

Leaf spot caused by Cercospora personata (B. & C.) E. was generally prevalent and caused considerable injury and loss in South Carolina, Georgia, Florida, Alabama, Tennessee, and Arkansas. The damage to the crop in South Carolina was about 90%, and the loss was estimated at 15%. As high as 75% of the crop was injured in Georgia, resulting in a probable loss of 5-10%. In Florida the loss was reported as probably 2-3%. In Tennessee a loss estimated at 10,000 bushels resulted from 5% injury. No estimates of losses due to this disease were made in Alabama and Arkansas, but it was reported as common and serious in both states. In the latter state it was said to be about the only serious trouble observed.

Dates when the disease was first noticed were reported as follows; South Carolina, June; Florida, July; Georgia, July 1; Tennessee, July 15.

J. A. McClintock reported that in Georgia the disease was "especially bad on Spanish peanuts, many of the leaves having fallen before the normal time for harvesting the crop."

Root rot caused by Sclerotium rolfsii Sacc. was local in South Carolina and Tennessee, general in Georgia, where it caused a loss estimated at 5%, and present in Florida, Alabama, Texas, and Hawaii.

Root rot caused by Ozonium omnivorum Shear was prevlaent in Texas, causing a loss estimated at 1%.

A wilt or stem rot suspected as being caused by Rhizoctonia sp. was reported from Greenville County, Virginia.

PEPPER

Bacterial wilt caused by Bacterium solanacearum E. F. S. occurred in Texas, but was unimportant.

Root rot caused by Sclerotium rolfsii Sacc. was general in Georgia, causing as high as 50% injury to the crop in some cases and a loss estimated at 5%.

Alternaria sp. causing leaf spot, mold, and fruit rot, occurred in New Jersey (reported as Macrosporium sp.), Delaware, Georgia, Kansas, and New Mexico. It was apparently not very important in any of these states, although rather common in New Jersey and Kansas. In New Mexico the disease caused a blight of Chile peppers, girdling and killing the stems, and also attacking the fruits, resulting in a loss estimated at 3%.

Leaf spot due to Cercospora sp. was common in Florida where it caused considerable trouble, particularly in the late fall and winter crop. Spraying with Bordeaux mixture was not generally practiced and when used was not always successful in controlling the disease.

A wilt apparently caused by Fusarium sp. caused a loss estimated at 5% in Orange County, California, according to D. G. Milbrath. It was found also in Tennessee, where it was unimportant.

Fusarium wilt caused by Fusarium annuum was reported by L. H. Leonian as serious on Chile pepper in New Mexico. (See also New Mexico Agr. Exp. Sta. Bul. 121 : 1-32, 1919). It appeared in early July and caused losses varying from 10-90% of the crop. It was said to be "confined to wet fields and stimulated by over-irrigation and lack of drainage. If planted on well drained and drier soils, the plants will remain free from disease."

Anthracnose caused by Gloeosporium piperatum E. & E. was reported from Delaware (not common), Alabama (common), and Georgia (general; with Colletotrichum sp. and Macrosporium sp. causing a loss estimated at 25%.)

Anthracnose caused by Colletotrichum nigrum E. & H. was common in New Jersey, and occurred also in Georgia.

Leaf spot caused by Phyllosticta sp. was reported from Alabama.

Mosaic, cause unknown, occurred in New Jersey (common but apparently of little importance), Indiana (local, not serious, causing no loss), Georgia (estimated loss 1%), and Florida (very serious locally, more common than before).

Root knot caused by Heterodera radicicola (Greef.) Müll. was found on peppers infected with mosaic, in the region of Ft. Myers, Florida; and on Chile peppers in Dona Ana County, New Mexico, where it caused a loss of 5%.

A fruit rot, cause undetermined, was reported by C. H. Philpott as causing slight damage locally in Missouri.

Spotting, of unknown cause, was reported in March from Florida, in the vicinity of Ft. Myers, by G. K. K. Link, as follows:

> "Most of the pepper fields are a sorry sight and have not produced a crop since November. Such fruit as is produced is gnarly, rough and small.... Some of the fruit produced in diseased fields is spotted. but in general the disease is manifested by a dwarfing of the plants, a spotting of the stems and leaves and a dropping of the foliage. The cause is not known and the disease has not been named."

Leaf fall, cause not known, resulted in heavy losses in New Jersey.

Crinkled leaf, thought to be due to soil conditions, was locally present in Florida.

Sun scald was reported as common in New Jersey, Indiana, and California.

RHUBARB

Leaf spot caused by Alternaria sp. occurred in Ramsey County, Minnesota.

Anthracnose caused by Colletotrichum erumpens was reported to be general and severe in Philadelphia County, Pennsylvania, appearing late in the season. The disease also occurred in Illinois.

Leaf spot caused by Ascochyta rhei E. & E. was found in Indiana wherever rhubarb was grown.

Leaf spot caused by Phyllosticta sp. was reported from Pennsylvania, where it was generally prevalent, although the estimated loss was slight; from North Dakota, where it was local and unimportant; and from Missouri, where it was common and caused losses ranging from slight to severe.

A bacterial crown rot was local in Missouri. In one instance it was said that three attempts had been made to grow rhubarb, but were unsuccessful because of this disease. It was found on the varieties Linneus and Victoria, the latter being the more resistant, according to the grower.

SALSIFY

White rust caused by Albugo tragopogonis(DC) Gray was common in Iowa, where it was most prevalent in the northern half of the state. The injury caused was reported as a trace. The disease was also reported from Whitman County, Washington.

SPINACH

Blight (cause undetermined).

Blight or mosaic was reported from New Jersey, Ohio, Texas, and California. It was serious wherever found. In New Jersey it was said to be complicated with attacks of aphids. It was reported that in Ohio the fall crop of spinach was destroyed by what was thought to be this disease. It appeared shortly after germination and progressed very rapidly, affecting at the same time and with equal severity fields separated in some cases by 30 miles. Some of these fields had produced good crops in the spring. Aphids were present but not in large numbers. In Texas the disease was especially severe in the vicinity of Austin according to L. R. Hesler, who visited the state in March. In this region about 3000 acres are grown. An average of probably one-third of the crop was affected and from 5-10% of the plants killed, causing a reduction in yield roughly estimated at 15%. In one field the reduction was 2000-6000 baskets. At the time the fields were examined no aphids were found, although apparently some had been present previously. The disease was found on spinach grown on soil which had never been planted to that crop before. It was found that the fertility or type of soil, or the use of fertilizers had nothing to do with the distribution of blight. In one case the variety (?) Viroflay seemed to be more susceptible than Bloomsdale. The disease was also found in the Rio Grande Valley in the vicinity of Mercedes, but not so generally as at Austin. In California D. G. Milbrath reported that a slight trace was present in most fields in the Imperial Valley and that it was severe in Los Angeles County.

A disease reported as blight caused by Fusarium sp. was found in Idaho, where it was said to be severe in gardens at Moscow, killing 75% of the plants.

Downy mildew caused by Peronospora effusa Rabenh.

In 1919 downy mildew was reported from Ohio, Texas, and California. In Texas it was prevalent and severe. L. R. Hesler reported that in one case the variety Bloomsdale (curly) was most affected. It was severe also in California wherever spinach was grown. In the Coachella Valley the loss was estimated at 15%, and in the Imperial Valley it was severe. D. G. Milbrath thinks that much of the disease could be avoided by more careful regulation of the irrigation water.

Anthracnose caused by Colletotrichum spinaciae E. & H.

Anthracnose was reported by L. R. Hesler from Louisiana and Texas. In Louisiana it was general but did little damage. In Texas it attacked the older plants and those affected by blight.

Other diseases.

Damping-off, caused by Pythium debaryanum Hesse, was reported from Connecticut as much more prevalent than usual, causing a moderate amount of injury.

Leaf spot caused by Heterosporium variabile Cooke was reported from Green County, Missouri, where it caused 50% injury to the crop, and was said to be more severe on the fall-sown crop; from the vicinity of Austin, Texas, where it was general but not serious; and from California, where it was very severe in the Sacramento Valley, according to D. G. Milbrath.

Black mold caused by Cladosporium macrocarpum Preuss. was reported by L. R. Hesler as very abundant in the vicinity of Mercedes, Texas, causing damage ranging from moderate to severe. In most cases it followed downy mildew and anthracnose.

Rust, thought to have been caused by Puccinia subnitens, was reported from Washington.

Frost injury was reported from Texas and Washington.

SWISS CHARD

Leaf spot caused by Cercospora beticola Sacc. was reported from Kentucky, where it caused 2% injury in the fields at the Experiment Station; from Missouri, where it caused considerable damage locally; and from the District of Columbia.

TARO (Colocasia spp.)

Rot of corms caused by Pythium debaryanum Hesse was reported by C. W. Carpenter from Hawaii, where it was said to be the most common and destructive rot of this crop. Crop rotation and applications of lime were suggested as control measures, although further experimental work on the subject is needed.

Phytophthora colacasiae Rac. (?) occurred in Oahu, Molokai, and Hawaii on taro leaves.

Rot caused by Sclerotium rolfsii Sacc. was reported from Hawaii on corms in storage.

TOBACCO

Black root rot caused by Thielavia basicola (B. & Br.) Zopf. was reported from Connecticut, Georgia, Ohio, and Wisconsin. In Connecticut it occurred in the usual amounts, and caused moderate damage. In Georgia it was generally prevalent, causing 100% injury in some cases, and a loss estimated at 5%. In Wisconsin, where it was said to be ordinarily the most serious disease of tobacco, high soil temperatures in the latter part of the summer prevented it from doing as much injury as usual. However, the disease made enough headway during the cooler weather in June and on badly infested soils to cause considerable loss. In Ohio there was very much less than usual, and the loss was negligible, because of hot weather.

Controlling the disease by steaming the plant beds was said to give good results in Ohio, although in 1918 this method, used in alternate years, had been reported from the same state as unsatisfactory.

Mosaic (cause undetermined) was reported as locally present in Virginia, Georgia, Ohio, and Indiana; and as generally prevalent in Massachusetts, Connecticut, and Wisconsin. Although individual fields were in some cases rather badly infested, the total losses were small. It was said that in one field in Virginia the disease was especially heavy near affected pokeweed.

Angular leaf spot caused by Bacterium angulatum was said to be prevalent and very destructive in Virginia, causing a loss estimated at more than 10%. Some tobacco fields were abandoned on account of this disease.

"Wild fire" caused by Bacterium tabacum Wolf & Foster was also reported from Virginia. It was often associated with the angular leaf spot, but was not so generally distributed nor so important, although in some cases it was even more destructive. The loss caused by it was estimated at 2%.

Hollow stalk, thought to have been caused by Bacillus carotovorus Jones, was reported from Connecticut (one report).

Leaf spot caused by Cercospora nicotianae E. & E. was reported from Georgia as generally prevalent and as the most serious disease of tobacco in the state, causing a loss estimated at 5%.

Damping-off caused by Pythium debaryanum Hesse and Rhizoctonia sp. was reported from Ohio and Wisconsin. In the latter state it was considerably more abundant than usual in May and June, and caused a shortage of plants in many cases. Good seedlings were finally obtained from many beds which had been abandoned, however.

Fusarium wilt caused by Fusarium tabacivorum Del. was reported from Ohio as doubtfully present in one field.

Red root rot of undetermined cause, but thought to be due to a Fusarium or to Pythium, was reported from Connecticut as serious in several fields.

Root knot caused by Heterodera radicicola (Greef.) Müll. was reported from Ohio.

Potash hunger was said to be serious in certain fields in Connecticut.

Rust, of non-parasitic origin, was reported as following mosaic in Massachusets and Connecticut. In the former state it was said to be more common on the broadleaf type. This or a similar disease was also reported from Pennsylvania by field men of the Bureau of Crop Estimates.

Orobanche ludoviciana Nutt. was reported from Warren County, Ohio.

Mr. G. M. Darrow,
Horticulture & Pomology,
Bureau of Plant Industry.

E. A. Siegler

THE PLANT DISEASE BULLETIN

Issued By

THE PLANT DISEASE SURVEY

SUPPLEMENT 11

Cotton, Sugar Cane
Diseases of Forest Trees, Ornamental and Miscellaneous Plants
in the United States in 1919.

June 15, 1920

BUREAU OF PLANT INDUSTRY

UNITED STATES DEPARTMENT OF AGRICULTURE

PLANT DISEASE SURVEY

1919

G. R. Lyman, Pathologist in Charge.

R. J. Haskell, Asst. Pathologist. G. H. Martin, Jr., Asst. Pathologist.

List of Collaborators of the Plant Disease Survey who have made the principal contribution to the 1919 annual summary.

It should be understood that many other collaborators and pathologists have assisted in gathering data within the states but the following list includes those who actually furnished state reports to the Washington office.

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	Prof. H. R. Rosen
Colorado......	Prof. J. G. Leach
Connecticut...	Dr. G. P. Clinton
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Iowa..........	Dr. I. E. Melhus
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Kansas........	Prof. L. E. Melchers
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	Prof. C. H. Philpott
Montana.........	Prof. D. B. Swingle
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	Prof H. E. Morris
Nebraska........	Dr. E. M. Wilcox
Nevada..........	Prof. C. W. Lantz
New Hampshire...	Dr. O. R. Butler
New Jersey......	Dr. M. T. Cook
New Mexico......	Prof. L. H. Leonian
New York........	Dr. Chas. Chupp
North Carolina..	Dr. R. A. Jehle
North Dakota....	Prof. H. L. Bolley
Ohio............	Prof. A. D. Selby
	Prof. W. G. Stover
Oklahoma........	Prof. C. D. Learn
Oregon..........	Prof. H. P. Barss
	Prof. C. E. Owens
Pennsylvania....	Prof. C. R. Orton
Porto Rico......	Mr. Julius Matz
South Carolina..	Prof. J. L. Seal
South Dakota....	Prof. Manley Champlin
Tennessee.......	Prof. S. H. Essary
Texas...........	Dr. J. J. Taubenhaus
Utah............	Dr. G. R. Hill, Jr.
Vermont.........	Dr. B. F. Lutman
	Prof. A. H. Gilbert
Virginia........	Dr. F. D. Fromme
Washington......	Dr. F. D. Heald
	Mr. B. F. Dana
	Mr. A. M. Frank
West Virginia...	Dr. N. J. Giddings
	Prof. Anthony Berg
	Dr. J. L. Sheldon
Wisconsin.......	Dr. R. E. Vaughan
	Prof. W. H. Wright

DISEASES OF COTTON, SUGAR CANE, FOREST TREES, ORNAMENTALS, AND MISCELLANEOUS PLANTS IN THE UNITED STATES IN 1919

Prepared by

G. Hamilton Martin, Jr.

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Foreword

The summaries of diseases of cotton, sugar cane, forest trees, ornamentals and miscellaneous plants were prepared from reports of collaborators and specialists in the Office of Forest Pathology and Sugar Plant Investigations, and from data gathered by special surveys - such as that conducted for sugar cane diseases in 1919.

The estimates of losses are in most cases those submitted by the collaborators or specialists.

In the case of forest trees, ornamentals and miscellaneous plants the volume of information at hand in preparing this summary has not been large in comparison with the data available on the more important food crops. The number of specialists engaged in the study of diseases of these plants is small, the average plant pathologist giving them only passing attention. Yet a complete annual summary, based on adequate information, would be of value to every plant disease worker and of special importance to teachers of forestry and landscape gardening, as well as to those giving courses in mycology and plant pathology. It is hoped that fuller reports on diseases of these plants may be secured in the future so that these summaries may become of greater value.

The role of wild plants as carriers of diseases of food crops is too well known to need exposition here. Hence plant pathologists, as well as students in mycological and pathological courses, should make a practice of noting and reporting all diseases observed in the course of field work, no matter how common and unimportant the host may be. In this Supplement it will be noticed that only one state reported rust on the dandelion for 1919, yet this rust has a wide range and is usually common. Full reports year after year on such diseases, although of little apparent importance today, may become of great value in future studies on plant disease geography and related subjects.

Greater attention should also be given to reporting diseases of ornamental and forest trees. Forest trees have a definite value as a crop and produce a definite yearly increment. The destruction of our chestnut forests by chestnut blight is not only causing a great loss, which can be measured in terms of the present stand, but the permanent extinction of the chestnut as a forest tree represents an inestimably greater loss. The shade trees of our dooryards and parks have an economic, social and aesthetic value far above that of the board feet they contain.

COTTON

In comparing the estimates and reports of 1918 and 1919 on the amount of crop injury and losses from the various cotton diseases it appears that on the whole a greater amount of loss from disease occurred in 1919 than in 1918. Throughout the cotton belt in 1919 late spring and early summer rains assisted materially in producing favorable conditions for some of the more serious diseases.

The accompanying chart (Fig. 42) shows the possible total production of cotton in bales, in the principal cotton producing states if there had been no loss through disease during 1919. There is also shown the estimated reduction in the number of bales and the actual production for the same year.

State	Production 1919 (000 omitted)	Reduction 1919 due to diseases
Texas	2700	439
Georgia	1730	460
S. Car.	1475	192
Miss.	946	141
N. Car.	875	154
Okla.	930	92
Ark.	830	72
Ala.	715	97
La.	300	33
Tenn.	298	33
Calif.	102	-
Ariz.	75	25
Mo.	60	-
Va.	22	3
Fla.	17	-
Others	7	-

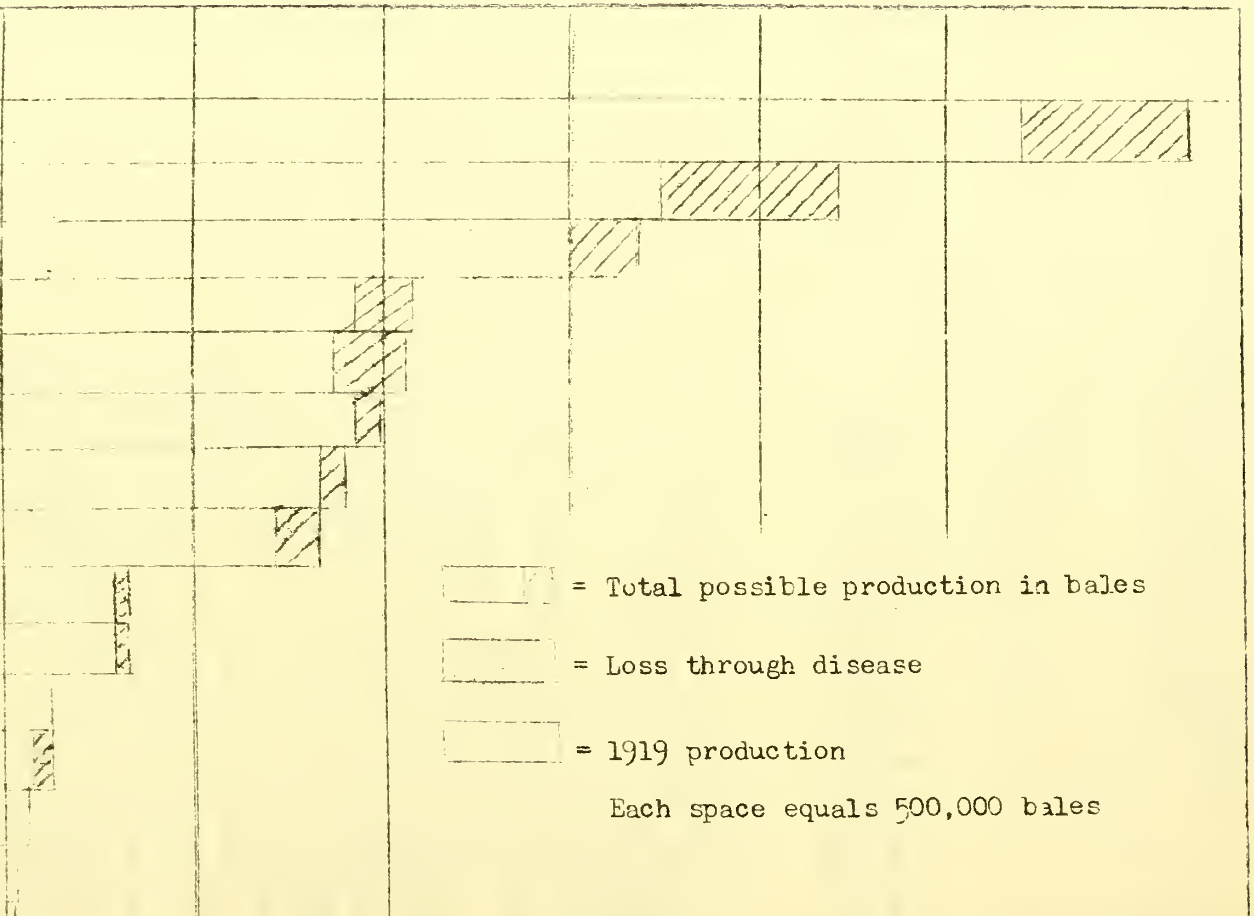


Fig. 42. Production of lint cotton by states, 1919 and reduction in loss from diseases.

Wilt and anthracnose probably caused about the same total losses, but, due to the fact that wilt is confined to sandy soils and anthracnose generally distributed over the entire cotton area, the local wilt losses greatly exceeded those from anthracnose. That is to say, wilt in frequent cases causes from 50-90% loss on sandy soils but because it does not occur on clay soils the average state loss is very materially reduced. Anthracnose on the other hand never causes such severe losses as wilt but because of its quite general occurrence the average for the United States is about the same. Root knot and angular leaf spot were also important. Ozonium omnivorum was important locally in Texas, where it undoubtedly produced more damage than all the other diseases combined. Malnutrition, or "rust", continued to bring about its usual amount of loss in situations where an effort is made to raise cotton on depleted soil.

Anthracnose caused by Glomerella gossypii (South.) Edg.

Anthracnose was reported from Tennessee, North Carolina, South Carolina, Georgia, Alabama, Mississippi, Louisiana, Texas, Oklahoma and Arkansas.

It was general throughout all the states reporting its occurrence except in Oklahoma, in which state the infection was local. In South Carolina it was very severe in two of the northern counties. In Alabama it was more severe than in 1917 and 1918. In Arkansas it was slight, and in all the other states it was only moderately severe.

The injury in Tennessee was about 25% resulting in an estimated loss of about 8%. In North Carolina the estimated loss was about 5%. In South Carolina the injury ranged between 15 and 20%, the average loss amounting to 3%. In Georgia the injury in local instances reached 50% with the total loss for the state averaging about 8%. In Alabama the loss was about 4%. In Mississippi there was considerable injury resulting in a loss of at least 5%. In Louisiana the injury was considerable - about 2% loss. In Texas the loss was estimated at about 1.5%. In Oklahoma the loss was about 1%. In Arkansas the percent of crop injury was about 20%, which produced a loss of about 1.5% in the state.

The accompanying map shows the estimated percentages of reduction in yield in the various states caused by anthracnose in 1919. These data, together with corresponding losses in bales, computed from estimated production, are given in tabular form in Plant Disease Bulletin Supplement 12, 1920.

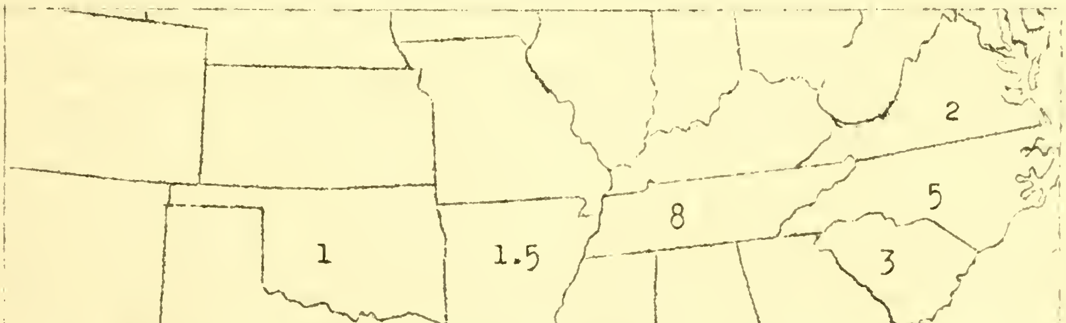


Fig. 43. Estimated percentage reduction in yield from anthracnose of cotton, 1919.

Due to a prolonged rainy season favorable weather conditions for the disease prevailed in all the states except Arkansas. In North Carolina the disease was more prevalent in the coastal counties due no doubt to the fact that more dampness prevailed.

Earliest appearances

May	- Arkansas	July	- Oklahoma
June 1	- Georgia	August 1	- Tennessee
July 1	- South Carolina	August 25	- Mississippi

When crop rotation was practiced and disease-free seed used satisfactory control was secured in North Carolina. No other reports on the success of control measures were received.

Wilt caused by Fusarium vasinfectum Atk.

Wilt was reported from Tennessee, North Carolina, South Carolina, Georgia, Alabama, Mississippi, Louisiana, Texas, Arkansas and New Mexico.

It was the most important cotton disease in Alabama and Louisiana, and second in Mississippi, Arkansas, South Carolina and Georgia.

New Mexico reported for the first time the occurrence of wilt within the state. It was reported by Leonian from Dona Ana County.

There were severe local losses in Tennessee in the cotton growing sections of the southwestern counties. North Carolina was severely attacked in the eastern half of the state. In South Carolina and Georgia it was prevalent in the Coastal Plain section wherever the growers attempted to grow varieties which were not wilt resistant. In Alabama it was general in the sandy soils, and more common and widespread than in 1918. It was quite severe during the early cotton season in the southern and middle sections. In the northern part where clay soils are found, wilt does not occur. In Mississippi it was quite common in local areas over the state. In Louisiana it was very prevalent and causing considerable damage. In Texas it was prevalent and scattered throughout the eastern and southern counties. In New Mexico it was of local occurrence.

The injury to the crop in Tennessee was thought to be about 1% which amounted to less than 1% loss. In North Carolina there were local injuries of about 50% which resulted in an estimated average loss of about 5%. In South Carolina the injury was about 5% with a 2% loss. In Georgia the injury was severe, in local cases it amounted to a 75% loss, averaging for the state about 4%. In Alabama the estimated loss approached 5%. In Mississippi the crop injury was about 5% with a loss of 4%. In Louisiana the loss averaged approximately 5%. In Texas and Oklahoma the loss was about 1%. In Arkansas the injury to the crop was near 20%, causing a loss of 2%. In New Mexico there was only a very small loss.

Dates of first appearance of wilt, according to collaborators.

Apr. 26	Arkansas	July 9	- Alabama
June 1	South Carolina	July 17	- Louisiana
July 1	Mississippi	July 21	- Georgia
July 1	Tennessee	August	- New Mexico.

The kind of soil largely governs the prevalence of wilt. It is well known that wilt is confined to sandy, and sandy loam situations, and does not occur on clay soils except in rare instances.

The accompanying map shows the estimated percentage of reduction in yield in the various states caused by wilt in 1919. These data together with corresponding losses in bales computed from estimated production are given in tabular form in Plant Disease Bulletin Supplement 12, 1920.

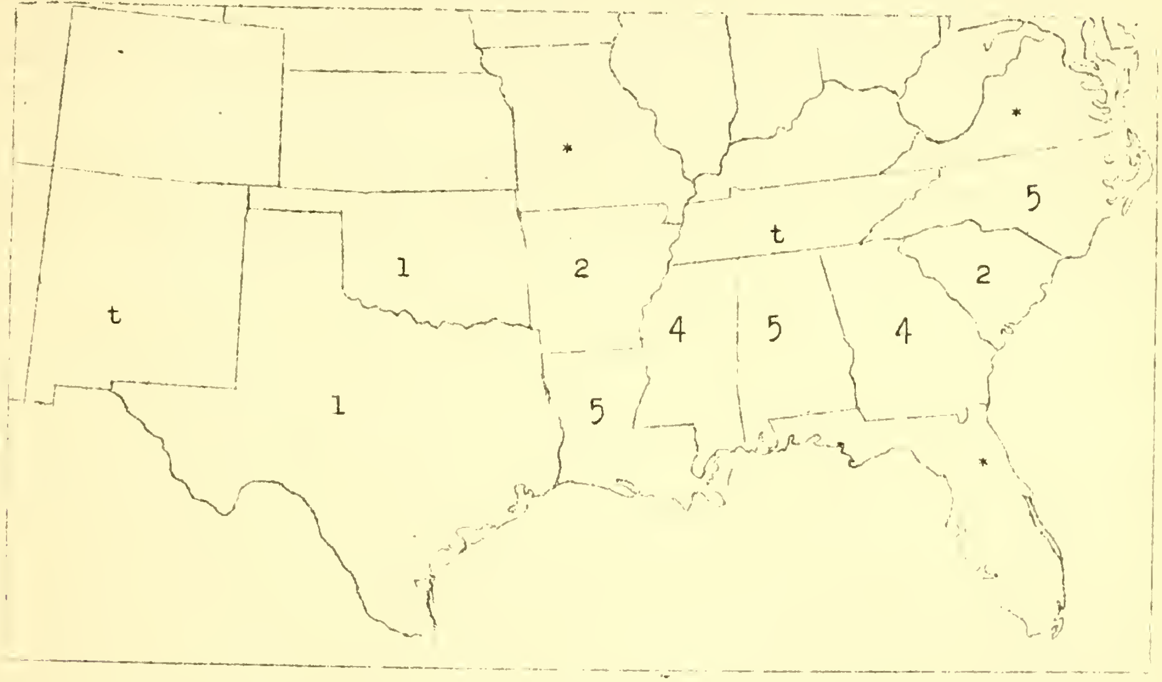


Fig. 44. Estimated percentage reduction in yield from wilt of cotton, 1919.

Very little wilt was experienced in North Carolina when wilt resistant varieties, such as Dixie, were used. In South Carolina, Dixie, Dixie Triumph and Dixie Cook - wilt resistant varieties - gave good results. In Louisiana, in Beauregard Parish, several fields which had been planted to commercial varieties showed about 25% infection, while three wilt resistant varieties (names not given in report) planted on a field which had previously shown 65% showed only ¼% infection. In Madison, Ouachita and Caddo Parishes the varieties Minden, Selection A, and Hybrid 143 - all wilt resistant cottons - showed from none to 3% infection in checks with other cotton. In Arkansas the Dixie and Express were successfully planted in wilt infested fields.

Angular leaf spot and boll rot caused by Bacterium malvacearum E.F.S.

This disease was quite general and common in all the cotton growing states except Virginia where it was local.

It was reported to the Plant Disease Survey from Arizona for the first time.

Angular leaf spot was more severe in Alabama in 1919 than during the previous seasons. This was probably due to the excessive rains which prevailed throughout July and August. In Louisiana and Arkansas it was severe, due in all probability to late rains. In 1919 it was said to be the most important disease of cotton in Oklahoma, Arkansas and Arizona, and second in importance in Tennessee.

More loss occurred from the presence of this disease during 1919 than in 1918. The crop injury ran high in Tennessee, reaching about 50%, which amounted to a loss of 2%. In North Carolina the loss averaged about 1%. In South Carolina individual instances of 70% injury were reported but the estimated loss to entire crop in state was about 2%. In Alabama there was only very slight loss. In Mississippi there was considerable injury to the crop which resulted in a 1% loss.

In Louisiana injury ran high although the loss at the end of the season was around 1%. In Texas the estimated loss was 1%. In Oklahoma the loss was about 1.5%. In Arkansas the loss was around 1.5%.

Black arm was reported by L. O. Watson in Cotton & Truck News Notes November 8, 1919 as being serious in Arizona only when in the path of a hail storm which damaged the cotton in that section. It has been present several years and occurs to some extent throughout that area.

The accompanying map shows the estimated percentage of reduction in yield in the various states caused by angular leaf spot in 1919. These data together with corresponding losses in bales computed from estimated production are given in tabular form in Plant Disease Bulletin Supplement 12, 1920.

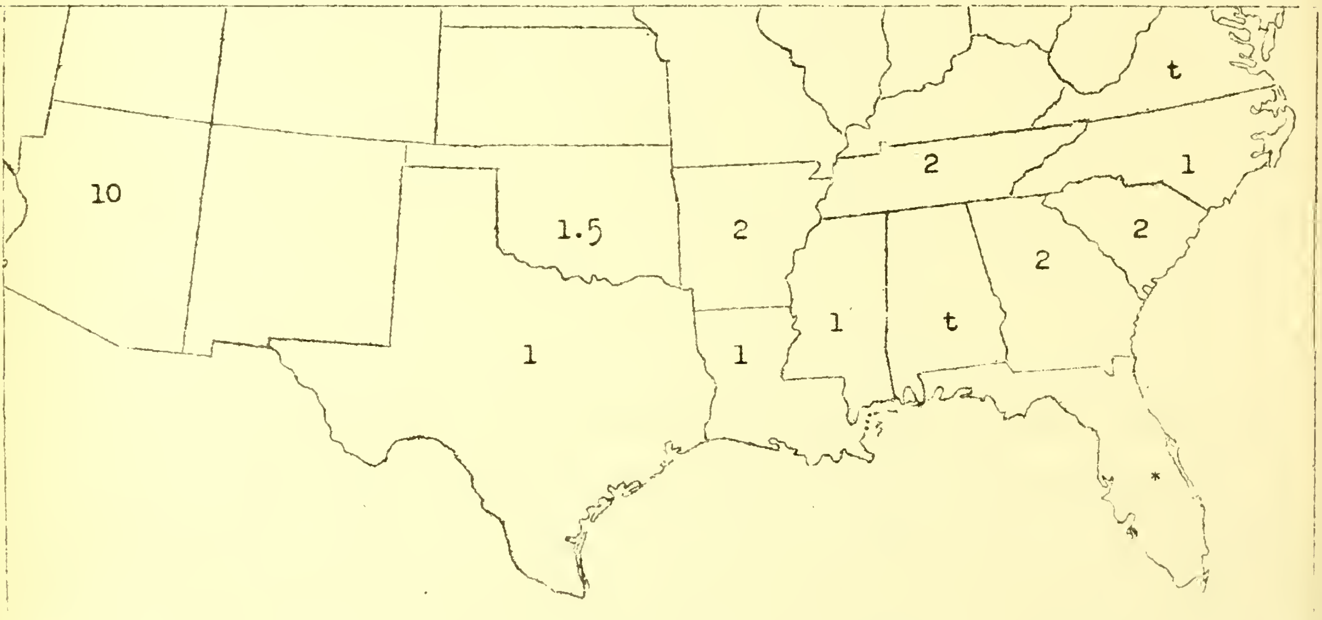


Fig. 45. Estimated percentage reduction in yield from angular leaf spot of cotton, 1919.

Earliest appearances
May - Arkansas
May 25 - Tennessee
June - Oklahoma
June 19 - Alabama
June 26 - Virginia.

No new methods or measures for control were reported to the Survey during 1919.

Root knot caused by Heterodera radicicola (Greef.) Müll.

The range of root knot was practically that of 1918. It was reported from South Carolina, Georgia, Alabama, Mississippi, Louisiana, Texas, Oklahoma and Arkansas.

The disease was of common occurrence in South Carolina, Texas and Arkansas. In Louisiana it was local. In Georgia general in the southern half of the state.

There was only a slight amount of root knot in Tennessee. In North Carolina an estimated loss of 1% was reported. In South Carolina the injury ranged from 0 to 100%, causing a loss of about 1.5%. In Georgia the loss was estimated at 4%. In Alabama and Mississippi the losses averaged about 2%. In

Louisiana the crop injury was slight and the loss 1%. In Texas and Oklahoma the loss was about 5% and in Arkansas a trace.

The accompanying map shows the estimated percentage of reduction in yield in the various states caused by root knot in 1919. These data together with corresponding losses in bales computed from estimated production are given in tabular form in Plant Disease Bulletin Supplement 12, 1920.

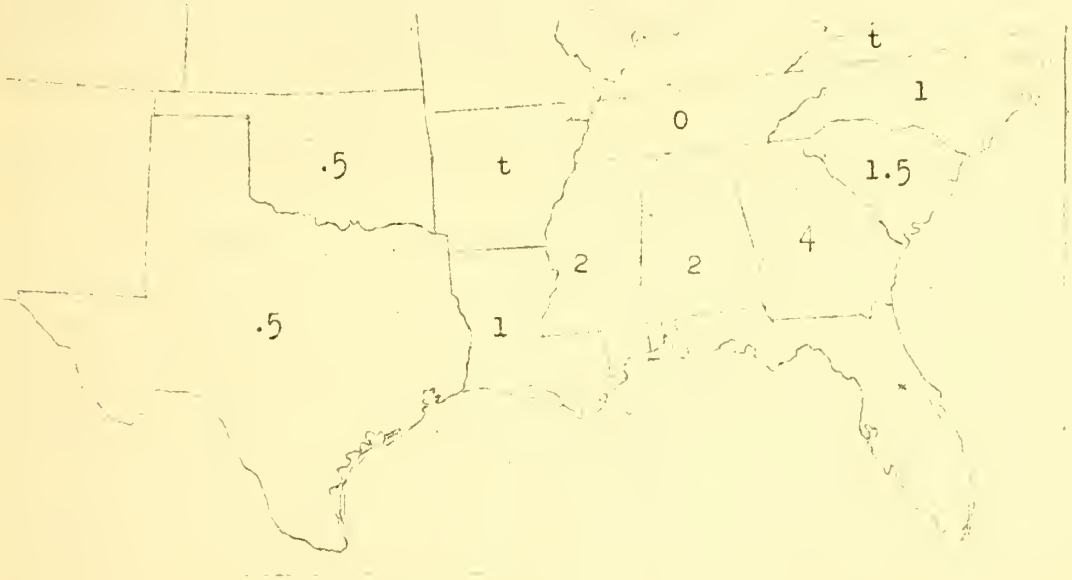


Fig. 46. Estimated percentage of reduction in yield from root knot of cotton, 1919.

Rotations of one to three years with root knot immune crops constitute the best method of control. Since wilt frequently, if not usually occurs on root knot infested lands, the use of wilt-resistant varieties of cotton is always advocated for such fields. J. A. McClintock stated that in Georgia root knot was serious on infested soil where susceptible varieties of crops had been grown without rotation, but that a fairly good crop of cotton could be grown for one year on soil that had been badly infested for the past several years where resistant varieties had been used and crop rotation practiced.

Root rot caused by Ozonium omnivorum Shear

Root rot was reported during 1919 from Texas, Oklahoma, Arkansas and Arizona. It was reported from the additional state of New Mexico in 1918.

The disease was general in the cotton areas of Texas and Oklahoma, also in the southern boundary tier of counties of Arkansas.

The epidemic in Texas resulted in a loss of about 10%. In Oklahoma the loss ran as high as 25% in local fields while the estimated average was about 3%.

Malnutrition (non-parasitic)

Malnutrition, known locally in certain localities as rust, was reported from Tennessee, North Carolina, South Carolina, Georgia, Alabama, Mississippi, Louisiana and Arkansas.

It was prevalent in the cotton districts of North Carolina and South Carolina and locally in Alabama, Mississippi and Louisiana.

The type of soil appeared to affect the severity and distribution of the disease in Arkansas as considerably more injury was found on the impoverished soil - such as slate soils, coarse sandy soils and river bottoms - than on that which contained the necessary plant food requirements. In Georgia where large losses occurred in 1918, favorable weather conditions with the use of more potash in the fertilizers improved the situation. It was not observed in the places where it was so prevalent in 1918. In North Carolina many fields were enriched by adding humus, stable manure and potash. These additions were found to act favorably.

The injury and estimated crop losses in North Carolina amounted to about 3% In South Carolina the injury was between 25 and 30% with a loss of about 1-2%. In Arkansas a loss of about 2% took place.

The accompanying map shows the geographical distribution of root rot.

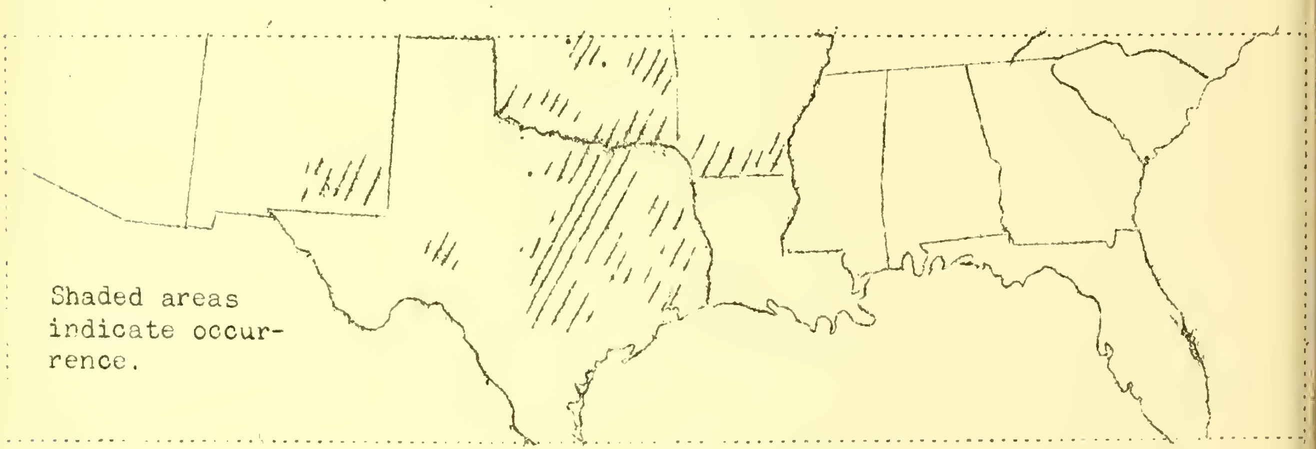


Fig. 47. The present known geographical distribution of Ozonium omnivorum on cotton according to records of the Plant Disease Survey.

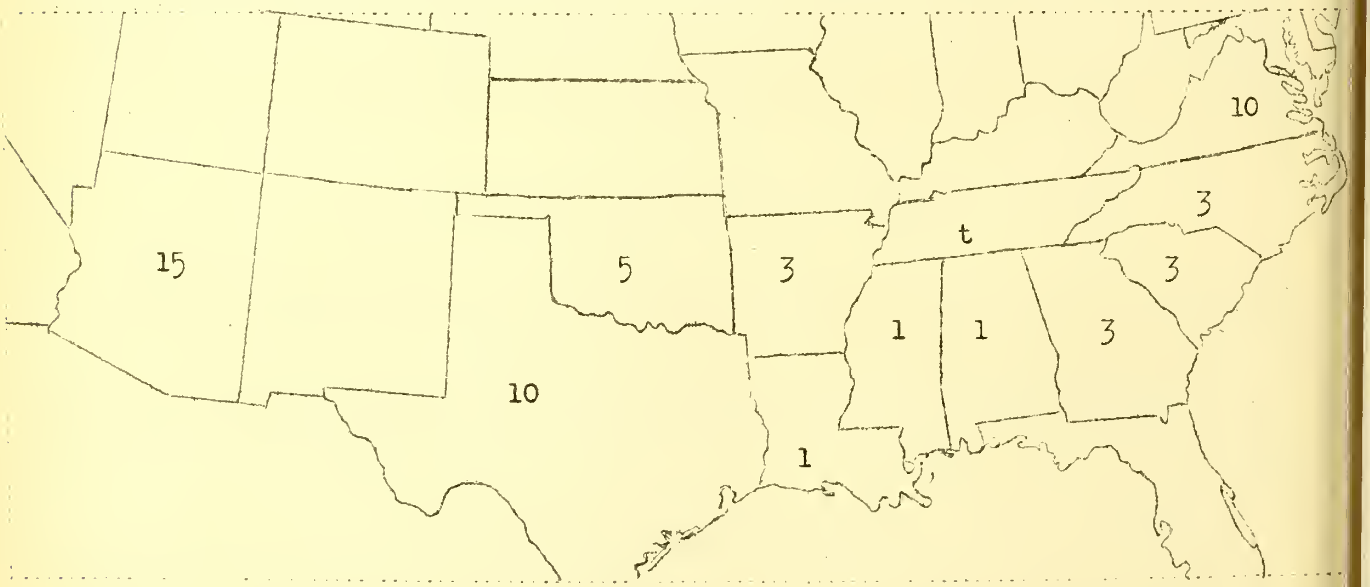


Fig. 48. Estimated percentage reduction in yield from all diseases other than anthracnose, wilt, angular leaf spot and root knot. Among the diseases concerned are root rot, caused by Ozonium, sore shin, etc., caused by Rhizoctonia, and miscellaneous leaf spots and boll rots.

Leaf spot caused by Cercospora gossypina Cke.

This very common disease of cotton occurred generally but was only reported to the Survey from South Carolina, Texas and Oklahoma. In South Carolina it was local. In Oklahoma it was somewhat scattered over the state, appearing in seven counties. In Texas it was prevalent. Plenty of moisture in Oklahoma afforded a favorable growing condition for the causal organism. In many cases it followed angular leaf spot but in some fields the organism itself appeared to have caused the leaf injury and where such seemed the case, the infection was bad.

Sore shin caused by Rhizoctonia sp.

Sore shin was reported from Virginia, Georgia, Alabama, Texas and Arizona. The disease was local in all these states except Georgia where it was said to be general. In Virginia the disease was severe early in June in Greensville and Brunswick Counties. This necessitated the plowing up of some crops and replanting many of the fields. The trouble disappeared largely as the season advanced. In Georgia the crop injury ran as high as 50% causing individual estimated losses of about 10%. In Texas there was practically no loss. In Arizona there was a 10% loss to the young crop in the early part of the season which required a replanting in most sections of the state. Considerable rains furnished favorable weather conditions.

Earliest report June 6, in Georgia.

Alternaria leaf spot caused by Alternaria sp.

Alternaria leaf spot appeared in South Carolina (local) and in Arkansas (followed Bacterium malvacearum which destroyed much of the foliage). The weather conditions were unfavorable to the disease in South Carolina.

Other diseases

Boll rot caused by Diplodia sp., and other fungi was reported general in Arkansas, but not severe. A 1% crop injury was reported. Earliest report was in September.

The rotting of bolls caused by wet weather was reported from Tennessee, Mississippi and Oklahoma. In Tennessee the seed sprouted and the lint was badly damaged by the rain. In Mississippi the rotting of the seed caused considerable alarm as it affected the planting supply of staple seeds for 1920.

Lightning injury was reported by D. C. George as occurring in Arizona. He has provided the following interesting statement:

> "It is a matter of common knowledge to cotton growers of the southern states that cotton fields are liable to injury by lightning. What appears to be an injury of this type has recently been investigated by this office. A field located 10 miles southeast of Phoenix near the foothills exhibited a characteristic lightning injured spot. The spot is located on the north side of the field and is approximately 100 yards south of an irrigation canal. When visited by the writer a dozen or more plants in the center of the spot were completely killed. The dead plants presented a scorched or burned appearance and none of the leaves had been shed. The plants adjoining were not completely killed but showed evidence of severe injury. This injury is characterized by a partially burned or scorched

appearance of the foliage as a distinct chocolate brown color of the stems, branches and leaf petioles. This color extends from a point 6 or 8 inches from the growing point of the various parts to the surface of the soil. Examination of the cambium, or the layer between the bark and woody part of the plant, reveals a dark brown or black color extending the entire length of the chocolate colored area. No discoloration of this layer was apparent in the parts of the stems below the soil surface or in the roots. The most striking effect was the peculiar flattened and twisted condition of the stems and other parts at the points where the electrical charge apparently entered the plant. Often the parts struck would droop at the point of entrance but seldom was there a wilting of the terminal portions beyond this point. In fact in most instances a normal color prevailed among the terminal portions and the plant had every indication of continuing growth. No difficulty was experienced in detecting injured from non-injured plants, as the chocolate colored area was not apparent on the latter plants. The area over which the stroke distributed itself was nearly circular in outline, the greater diameter being approximately 120 feet. Dead plants only occupied the exact center of the spot, the injury diminishing toward the periphery."

SUGAR CANE

Mosaic (cause undetermined)

On account of the seriousness of the mosaic disease of sugar cane, a survey was conducted by the Office of Sugar Plant Investigations throughout the southern sugar cane belt to ascertain the extent and seriousness of the disease.

Table 38. Counties and number of localities visited by field men engaged in the sugar cane survey, 1919.

State	County	No. of districts visited	State	County	No. of districts visited
Alabama	Baldwin	1	Florida	Putnam	1
	Mobile	1		Suwanee	2
				Taylor	1
Florida	Columbia	1		Alachua	3
	De Soto	1		Madison	1
	Duval	1		Polk	1
	Escambia	2		Dade	1
	Gadsen	11			
	Leon	1	Georgia	Charlton	2
	Liberty	1		Grady	5
	West Palm Beach	2		Thomas	2
	Jackson	2		Lowndes	1
	Jefferson	3		Ware	1

State	County	No. of districts visited	State	County	No. of districts visited
Georgia	Wayne	1	Louisiana	Plaquemines	7
	Pierce	1		Pointe Coupe	7
	Clinch	1		Rapids	5
				St. Charles	10
Mississippi	Harrison	1		St. James	14
	Jackson	1		St. John The Baptist	12
	Jefferson	1		St. Landry	8
	Adams	1		Tangipahoa	1
				Terre Bonne	2
Louisiana	Ascension	5		Vermillion	2
	Assumption	1		Orleans	2
	Avoyelles	1		Iberia	2
	East Baton Rouge	1		St. Martin	3
	West Baton Rouge	9		St. Mary	1
	West Filiciana	1			
	Iberville	5	Texas	Brazos	1
	Jefferson	1		Brazoria	1
	Lafayette	4		Fort Bend	1
	Lafourche	4		Wharton	1

In connection with this survey all other diseases affecting cane were noted, and, in this way, much valuable information of a general nature was collected. These data were made available to the Plant Disease Survey, and this summary is based mostly on the reports of the survey men. Data were gathered in Georgia, Florida, Alabama and Louisiana and each state in the district of the greatest production of sugar cane was surveyed. The following map and table preceding will show approximately the territory covered and will give a fair idea of the number of counties entered and the districts in each county surveyed.

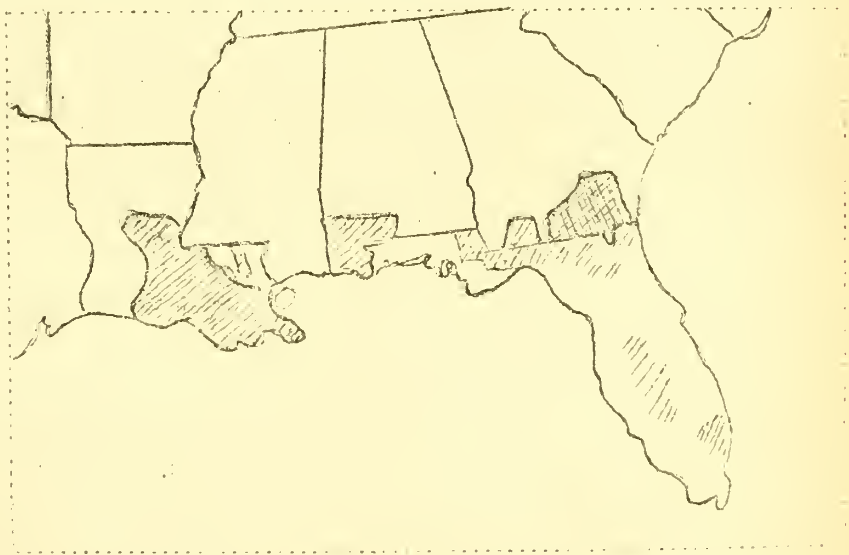


Fig. 49. Map showing the approximate location of areas covered by field assistants on sugar cane disease survey, 1919.

Mosaic was found to be present in Georgia, Florida, Alabama, Mississippi and Louisiana by field assistants on the sugar cane survey under the direction of Dr. E. W. Brandes, pathologist, Sugar Plant Investigations, and in Porto Rico. These findings were the result of considerable survey work in the southern states. The disease was most abundant in Louisiana.

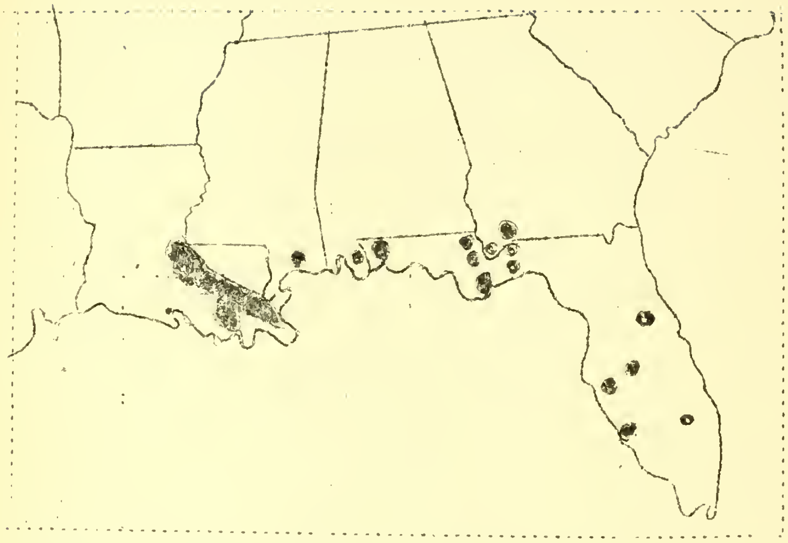


Fig. 50. Map showing the location of areas of sugar cane infected with mosaic. (U.S.D.A. Bul. 829 Fig. 1, p. 5.)

The most heavily infested large area in Louisiana, and consequently in the United States, is between Hutcher and Reserve, where about 75% of the plants on every plantation were infected. The amount ranged from 4-30% from this district to New Orleans and from New Orleans to the lower extremity. In the Bayou-Lafourche district 1-8% of the plants were infected.

In the vicinity of Cairo, Georgia (Grady County) the infection ranged from less than 1% to 75%, or more, in fields where the disease was present. So far the infected plants are confined to the farms on the highways leading out of Cairo. In Florida the two principal infection areas were located at Mariana and Bristol. Purely local infections were found at Apalachicola, Tallahassee, Punta Gorda, Palmetto, De Land, Winterhaven, Chattahoochee, Muscogee and Canal Point. In Alabama it was found at only one place, that in Baldwin County just over the line from Muscogee, Florida. In Mississippi, it was found at Biloxi, the only point in the state.

The loss in Georgia was from 1-5%. In Louisiana the loss was considerable.

Resistant strains in Georgia and Florida were the Japanese varieties, while the green chewing corn was the most susceptible. In Louisiana in the test plots at Audubon Park, New Orleans the head seedlings 1646, 1606, 1674 and 1797 appeared to be immune. The varieties which are common in the state and which proved to be very susceptible were Louisiana Purple, Louisiana Striped, D74, D95, L511, L218, L219, L226, L231 and L253.

Root rot caused by Marasmius plicatus and other fungi.

Root rot was reported from Georgia and Louisiana. The disease was abundant throughout Louisiana as shown in Fig. 51. Due to the extreme wet condition during 1919 the disease was not as severe as in 1918. The crop injury ranged between 5 and 10%, which resulted in considerable loss.

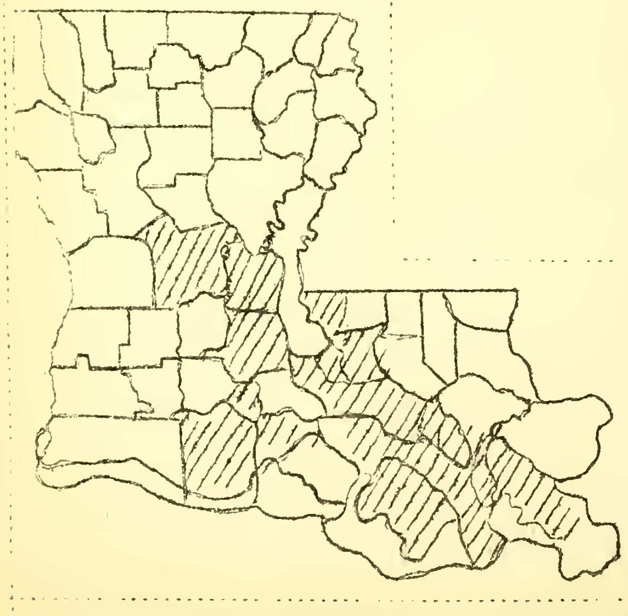
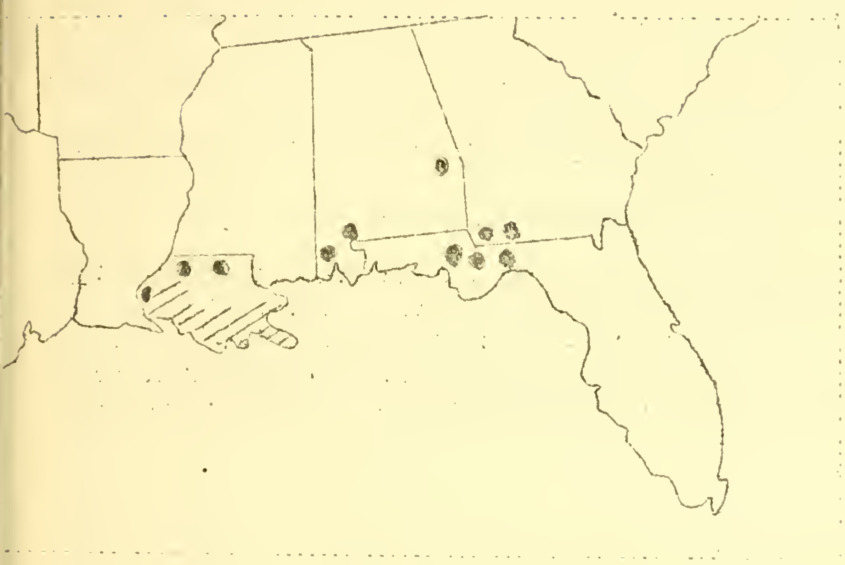


Fig. 51. Map of Louisiana showing the counties in which root rot (Marasmius plicatus Wak.) and other fungi were found by field assistants on the sugar cane survey, 1919.

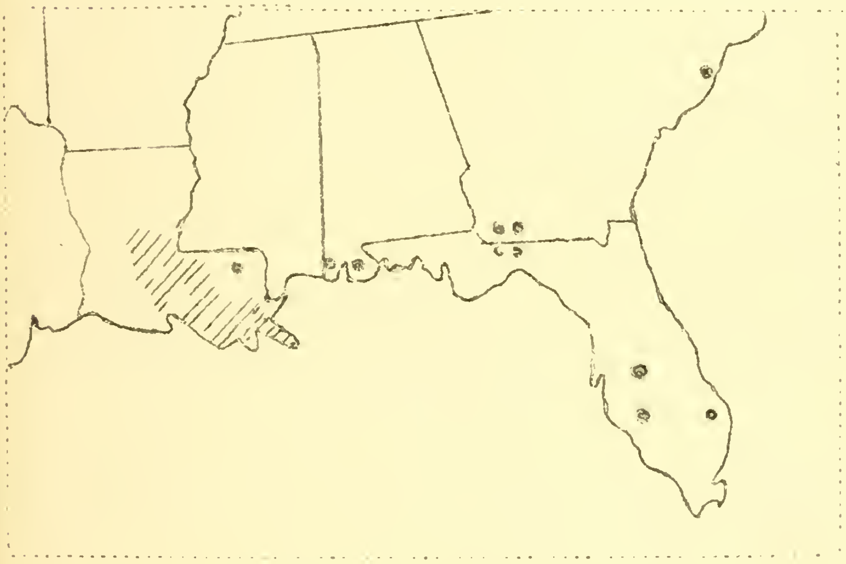
Red rot and red stripe caused by Colletotrichum falcatum



Red rot and red stripe were reported from Georgia, Florida, Alabama, Louisiana and Texas. In Louisiana the disease was prevalent. In Alabama it was abundant.

Fig. 52. Showing the location of areas of red rot in the southern cane belt.

Sheath rot caused by Sclerotium rolfsii Sacc.



Sheath rot was reported from Georgia, Florida, Alabama and Louisiana. As shown in Fig. 53 it was very prevalent over a large area in Louisiana. In the other states in which it was found it was mostly of local occurrence. In Georgia there were occasional losses of as high as 5%. In Louisiana there were local high crop injuries but practically no losses. In other states reporting, the losses were slight.

Fig. 53. Showing the location of areas of sheath rot in the southern cane belt.

Other Diseases

Leaf spot or ring rot caused by Leptosphaeria sacchari Van B. de H. was general in Alabama, where it brought about considerable loss.

Root knot caused by Heterodera sp. was present in Georgia and Florida. In Georgia the nematode was of general prevalence. The crop injuries ranged from 0-50% in cases of local infestations. The estimated loss averaged about 1%.

Pineapple disease caused by Thielaviopsis paradoxa De Seynes and Hohn was reported to have been occasionally present in Louisiana. The injury and loss were small. This was also the cause of poor germination in Dade County, Florida, in a few fields. (E.W.B.)

Smut caused by Ustilago sacchari Rab. was reported from New Mexico (Toos County).

Leaf spot caused by Cercospora longipes Butler was reported from Alabama (present in Escambia and Mobile Counties).

Leaf spot caused by Helminthosporium sacchari common in southern Georgia and northern Florida. (E.W.B.)

Rind disease caused by Melanconium sacchari abundant in all cane regions but no damage except to over-ripe cane in southern Florida. (E.W.B.)

Wrinkled top, cause unknown. As much as 5% of plants affected in some fields in Louisiana, Georgia and Florida. The growing point becomes twisted and distorted, and the new leaves are much wrinkled and shredded. Cane ceases to grow. (E.W.B.)

DISEASES OF FOREST TREES.

The following summary of forest tree diseases for 1919 was prepared from reports received by the Plant Disease Survey from state collaborators, from J. F. Collins and G. F. Gravatt, of the Office of Forest Pathology, and from S. B. Detwiler, of the Office of Blister Rust Control. Dr. Collins' initials appear in connection with his reports.

ASH (Fraxinus spp.)

A *leaf blight*, cause unknown, was reported from Forest Grove, Oregon.

Leaf spot, caused by *Cercospora fraxinites* E. & E., was reported from Texas as quite prevalent but unimportant.

Rust, caused by *Puccinia fraxinata* (Lk.) Arth., was more prevalent than usual in Connecticut, causing some leaf defoliation where abundant along the coast. It was of slight importance in Minnesota and Ohio.

ASH, Mountain (Sorbus sp.)

Rust, caused by *Gymnosporangium cornutum* (Pers.) Arth. (*Roestelia cornuta* (Pers.) Fries.), reported from Connecticut of uncommon occurrence.

BEECH (Fagus sp.)

Microstroma sp. was reported on *Fagus americana* in Illinois and on *Fagus* sp. in New Jersey.

Gloeosporium fagi (D. & R.) West., present in Connecticut. (J.F.C.)

Phyllosticta fagicola E. & M. present in New Jersey and *P. fraxini* E. & M. in Missouri.

BIRCH (Betula sp.)

Canker, caused by *Sphaeropsis conglobata* Sacc., occurred in Ohio.

Melanconium betulinum Schn. & Kze. present in Illinois on *B. alba*. (J.F.C.)

Phyllosticta betulina Sacc. present in New York on *B. alba* (J.F.C.)

BOX ELDER (Acer negundo)

Canker, caused by *Nectria cinnabarina* Fr., occurred in Ohio.

Sap rot, caused by *Polystictus hirsutus* Fr., occurred locally in Minnesota.

BUCKTHORNE (Rhamnus spp.)

Rust, caused by *Puccinia coronata* Cda., was reported on *Rhamnus* sp. in Vermont (earliest report July 15) and on *Rhamnus alnifolia* (first report May 30); and *Rhamnus cathartica* L. in Minnesota (first report on May 28 in Marshall County, later reported in Clay County). In Marshall County, Minnesota, a young hedge was found very heavily infected, while an old hedge nearby was only slightly infected. (See also leaf rust of oats Pl. Dis. Bul. Sup. 8, 1920.)

BUTTERNUT (Juglans cinerea)

Spot, caused by *Gnomonia leptostyla* (Fries.) Ces. & De Not. (*Marssonia juglandis* (Lib.) P. Magnus), reported from Iowa. A trace found.

CAMPHOR (Cinnamomum camphora)

Anthracnose, caused by Gloeosporium camphorae Sacc., reported from Baldwin County, Alabama, and Bell County, Texas (trace).

Canker, caused by Diplodia sp., a trace in Harris County, Texas.

CATALPA (Catalpa sp.)

Leaf spot, caused by Macrosporium catalpae E. & M., was reported from Rhode Island, Connecticut, (more evident than usual, three reports from New Haven County and one in Hartford County), Indiana (found in Marshall County June 23 - weather conditions favorable to the disease).

Leaf spot, caused by Phyllosticta catalpae E. & M., was present in New York, New Jersey (common at times causing heavy leaf fall), West Virginia, South Carolina (common, injury to trees about 60%,- found in Oconee and Greenwood Counties), Ohio (present in Cuyahoga, Wayne, Holmes, Tuscarawas, Morrow, Licking and Franklin Counties, earliest report June 19).

Heart rot, caused by Polystictus versicolor Fries., reported from Wayne County, Ohio.

Leaf wilt, caused by Sclerotinia sp., occurred in Ohio.

Sap rot, caused by Stereum versicolor Fries., was reported from Wayne County, Ohio.

Wilt, cause undetermined, was noticed in Wayne County, Ohio.

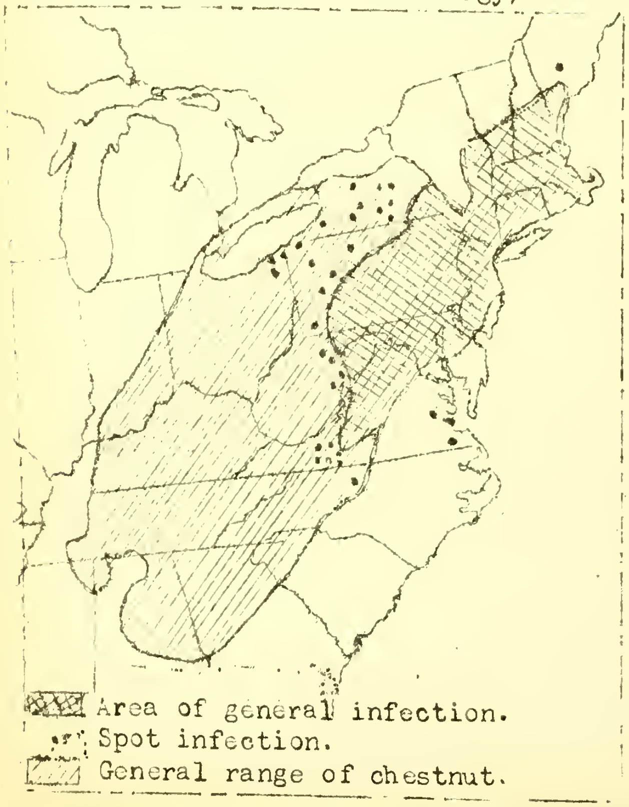
CEDAR (Thuja sp.)

Blight, caused by Keithia thujina Durand, reported from Lewis County, Washington.

Pestalozzia funerea Desm., present in Mississippi on T. occidentalis (J.F.C.)

CHESTNUT (Castanea sp.)

Blight, caused by Endothia parasitica (Murr.) And. (Prepared by G. F. Gravatt, Office Forest Pathology)


▩ Area of general infection.
⁘ Spot infection.
▨ General range of chestnut.

As shown by the map the chestnut bark disease extends in the native growth from Maine to North Carolina and west to Ohio. Observations and state reports show that the disease is steadily spreading southward and westward. In the northern part of Virginia approximately 90% of the chestnut trees are at present diseased while in this region five years ago not over 1% of the trees were infected. No indications of any decrease in the virulence of the disease have been noted so far. The chestnut growth of the Southern Appalachians apparently will be killed just as the growth from Maine to Southern Virginia is now dying.

In Alabama two infections on nursery trees shipped into the state were found by state authorities and destroyed. The continuation of the development of commercial chestnut orchards in regions outside of the range of the native chestnut is largely dependent upon whether state authorities keep nurseries that harbor this disease from shipping trees. In many cases the early stage of infection with the bark disease is impossible of detection by field inspection, therefore, no tree grown in an infested nursery is safe to be shipped into new territory. (G. F. Gravatt, March 1920).

Black canker, caused by Melanconis modonia Tul., occurred in Ohio.

Leaf spot, caused by Marssonia ochroleuca B. & C., reported from Ohio of normal prevalence in Ashland, Knox, Morrow, Stark, Tuscarawas and Wayne Counties.

DOGWOOD (Cornus spp.)

Canker, caused by Phoma corni Fckl., reported from Minnesota on cultivated dogwood in Kandiyohi County. Earliest report April 15.

Powdery mildew, caused by Phyllactinia corylea (Pers.) Karst., reported from Washington. Earliest report September 24 at Pullman.

Phyllosticta corni West., present in West Virginia. (J.F.C.)

ELDER (Sambucus spp.)

Powdery mildew, caused by Microsphaera grossulariae (Wal.) Lev. reported from Minnesota. Earliest report August 24, Ramsey County.

Rust, caused by Puccinia bolleyana Sacc. (Aecidium sambuci Schw.), occurred in Ohio.

ELM (Ulmus spp.)

Black spot, caused by Dothidella ulmi Duv., reported from Virginia, Tennessee, North Carolina, Ohio and Nebraska. (Present in Seward County, Nebraska)

Leaf spot, caused by Gnomonia ulmea (Sacc.) Thüm., reported from Nebraska and Minnesota. In the former it was quite common over the state. Earliest report in August. Favorable weather conditions for the disease due to quantity of moisture.

Branch canker, caused by Nectria cinnabarina (Tode) Fr., occurred in Massachusetts and Ohio.

Multiple bud, caused by Fusarium sp., occurred in Ohio.

Root rot, caused by Ozonium omnivorum Shear, was general in Texas. Estimated loss about 1%.

Leaf spot, cause unknown, reported from Kansas. Prevalent in Riley County, local in Sedwick County. Earliest report July 28.

HAWTHORNE (Crataegus spp.)

Rust, caused by Gymnosporangium clavariaeforme (Jacq.) D. C., reported from Massachusetts and Madison County, Alabama. Estimated loss slight. Gymnosporangium clavipes C. & P. (Roestelia aurantiaca Peck.), was more prominent than usual in Connecticut. Reported from Fairfield and Tolland Counties. Gymnosporangium globosum Farl., reported from Minnesota. Present in eight counties. Severe in Rice and moderately severe in Ramsey and McLeod Counties. Gymnosporangium juniperi-virginianae Schw., reported from Iowa by A. L. Bakke to have been found at Clarinda, June 11. Gymnosporangium sp. was reported from Illinois.

HICKORY (Carya spp.)

Anthracnose, caused by Gloeosporium caryae E. & D., occurred in South Carolina (common, producing about a 40% crop injury) and in Ohio.

Leaf mildew, caused by Microstroma juglandis (Ber.) Sacc., reported from

Orange County, Indiana, May 28.

HONEY LOCUST (Gleditsia sp.)

Powdery mildew, caused by Sphaerotheca sp., occurred in Ohio.

HORSE CHESTNUT (Aesculus hippocastanum)

Leaf blotch, caused by Guignardia aesculi (Pk.) Stewart (Phyllosticta paviae Desm.) (P. sphaeropsidea E. & E.), reported from New Hampshire, Connecticut, New York, New Jersey, Delaware, Virginia, Ohio, Indiana and Iowa. Common and causing a considerable amount of defoliation in most states.

Earliest reports - May 29, Indiana
July 22, Connecticut
September 15, Ohio.

JUNEBERRY (Amelanchier spp.)

Brown rot, caused by Sclerotinia fructigena (Pers.) Schr., reported from Ohio, present in Wayne County.

Leaf spot, caused by Dimerosporium collinsii (Schw.) Thüm., reported from Minnesota. (Earliest report April 25)

JUNIPER (Juniperus spp.)

Rust, caused by Gymnosporangium spp. (See apple rust, Pl. Dis. Bul., Sup. 9, 1920.)

LARCH (Larix sp.)

Valsa abietis Fries, reported from Ohio.

LOCUST, Black (Robinia sp.)

Leaf spot, caused by Septoria curvata (R. & B.) Sacc., occurred in Ohio.

MAGNOLIA (Magnolia spp.)

Anthracnose, caused by Colletotrichum sp., was common throughout South Carolina, affecting about 50% of the trees.

Blossom blight, cause bacterial, was reported from King County, Washington. (Earliest report April 29)

Leaf spot, caused by Spegazzinia ornata Sacc., reported from South Carolina, occurring in Beaufort, Charleston and Clarendon Counties. Severe in all cases.

MAPLE (Acer spp.)

Anthracnose, caused by Gloeosporium apocryptum E. & E., reported from New Hampshire (in Grafton County), Connecticut (apparently more prevalent than usual), Delaware, Oklahoma (in Garvin, Jefferson, Logan, Oklahoma and Payne Counties), Ohio (in Ashtabula and Cuyahoga Counties).

Earliest reports - June 17, Connecticut
June 19, New Hampshire
July, Oklahoma
August 1, Ohio.

Bark canker, caused by Cytospora sp., reported from Washington, where it apparently was the cause of death of street trees in Spokane.

Black specked leaf spot, caused by Rhytisma punctatum Fries., reported from South Carolina (in Greenwood and Oconee Counties), Ohio (in Clermont and Wayne Counties) and Minnesota (more or less common throughout state). Earliest reports - September 17, Ohio and September 24, Minnesota.

Leaf spot, caused by Phyllosticta spp., was reported from Connecticut, Ohio (P. acericola C. & E.) and Minnesota (P. minima (B. & C.) E. & E.).

Winter injury reported from Defiance and Richland Counties, Ohio.

Leaf scorch (non-parasitic) was reported from New Jersey, Ohio (quite prevalent) and Illinois. H. W. Anderson has furnished the following statement regarding this disease in Illinois:

"LEAF SCORCH OF HARD MAPLES IN ILLINOIS

"During the month of May, a serious leaf scorch of maples appeared in many localities in Illinois. This disease has attracted considerable attention and numerous inquiries have been received in regard to the possibility of it spreading to the healthy trees.

"Symptoms:- There are a number of types of the disease, all of which may appear in a single locality, but on a single tree the character of the injury is much the same. When slightly affected, the leaves show a mottled appearance on the upper surface with no dead areas. The under surface is bronze colored and does not show the distinct mottled appearance of the upper surface. In a more advanced stage the leaf area dies, the leaf becomes distorted, showing a curled or cup appearance. Parts of the tissues remain alive for some time, taking on a darker green color than the normal leaf. These dark green islands usually remain alive until the leaf falls. Sooner or later, almost the entire leaf is brown and dead and a great many of the leaves drop off at this stage. In an advanced stage the tree appears as though swept by fire. Before the leaves fall to any great extent, new leaves begin to appear from dormant buds. On other trees, another type of injury is noted. The entire surface both above and below takes on a bronze color with the exception of the main veins and the area immediately adjacent which remains a normal green. The entire tree may become affected or only a few limbs. It is more common, however, to find an entire tree in the same stage of the disease. If a single limb shows the trouble, it is usually one which is more exposed to the sun than the remainder of the tree, and upon examining the foliage on other parts of the tree, it is noticed that the mottled appearance is evident on all of the foliage. One of the peculiar characters of this injury is the fact that not all the trees in an area are affected, but only one here and there. For example, in Springfield where a long row of maples has been planted, all of the same species, there were only three showing the disease. Another peculiar thing is that one tree may show the symptoms described as applying to slightly affected trees while a neighboring tree will show the advanced stage at this season of the year (June 27). The portion of the leaf which dies first varies in different trees. In some cases the dead area is between the main veins and extends down to the petiole. In other cases it is confined to the outer (distal) of the leaf. In some cases it seemed to be confined to the area adjacent to the main veins, while the area between the veins will remain alive for some time.

"Hosts:- So far as observed in Illinois, the leaf scorch seems to be confined to the hard maple (Acer saccharum Marsh) and to the Norway maple. I have observed it only on the hard maple but have definite information that it also occurs on the Norway maple.

"Cause:- A careful examination of material from a great many sources failed to reveal any causal organism. The State Field Entomologist examined the material for insects which might cause the trouble and reports that none are to be found, and that there is no evidence of the trouble being due to insects. The fact that the disease is so wide-spread and has appeared for the first time this season, points to the fact that it is due to some climatic condition. Its wide distribution also argues against it being due to escaping gas in the ground or to fumes from industrial plants. There is no evidence that it is caused by winter injury. The bark at the base of the tree and the roots appear to be quite normal. This season has been unusual in many respects. The winter was mild and the buds expanded at an early date. On April 23 and 24, there was a heavy frost with minimum temperatures from twenty-four to thirty-one degrees in all parts of the state. Following this, there was a period of warm, rather dry weather. This was followed in May by a week of rather cold weather during which there was some rain every day. This was the week of May 16-21. It is probable, however, that the injury developed before this week of cold, wet weather, since different observers state that they saw the condition as early as the middle of May. It is probable that the trouble is the result of the low temperatures of April 25 and 26, followed by the relatively warm, dry weather of early May.

"Distribution:- The disease has been reported and specimens examined from Springfield, Decatur, Champaign, Urbana, Galesburg, Peoria, and Princeton. I should be pleased to learn anything further concerning the distribution of this disease in the state of Illinois and in other states."

Tar spot, caused by Rhytisma acerinum (Pers.) Fr. Although only reported from Connecticut, New Jersey, West Virginia and Minnesota, tar spot no doubt occurred also in Vermont, New Hampshire, Massachusetts, Rhode Island. New York, Pennsylvania, Maryland, Kentucky, North Carolina, South Carolina, Arkansas, Michigan, Wisconsin, Iowa, Nebraska, Idaho and Washington. In Preston County, West Virginia, J. Rubinger found a large percentage of the maple trees infected so much so that hardly a tree was free from the disease. Also that it appeared to be far more prevalent than he had ever noted it in New York or Michigan.

Mildew, caused by Uncinula aceris (D.C.) Sacc., occurred in Ohio.

The following list of maple species and fungi attacking them was submitted by Dr. J. F. Collins, Pathologist, Office of Forest Pathology, U. S. Department of Agriculture:

Microstroma sp. found on Acer platanoides in Ohio and Illinois; on Acer sp. in Pennsylvania.

Gloeosporium apocryptum E. & E. reported found on Acer platanoides in Maine and New York; on Acer saccharum in Pennsylvania, Virginia and Indiana; on Acer saccharum in New Jersey.

Sclerotium sp., reported found on Acer platanoides in Maryland; on Acer saccharum in New York.

Phyllosticta acericola C. & E. reported found on Acer rubrum in New Jersey; on Acer saccharum in New Jersey.

Cephalothecium roseum Cda. reported found on Acer sp. in Kansas.

Fusarium platanoidis Oud. reported found on Acer sp. in Virginia

Nectria cinnabarina (Tode) Fr. on Acer sp. in Pennsylvania.

Phyllosticta aceris Sacc. reported found on Acer sp. in Virginia.

OAK (Quercus spp.)

Anthracnose, caused by Gnomonia veneta (S. & S.) Kleb., reported from New Jersey (common), Ohio and Iowa (a trace).

Leaf blister, caused by *Taphrina coerulescens* (M. & D.) Tul. was reported from New York (on *Q. coccinea*), New Jersey (common), Pennsylvania, D. C. (on *Q. velutina*), South Carolina (common - 25% injury), Florida (heavy infection on shade trees at Gainesville) and Mississippi (common at Long Beach).

Brown checked root rot, caused by *Polyporus sulphureus* Fries., was reported from Minnesota as attacking the following oaks: *Quercus coccinea*, *Q. macrocarpa* and *Q. rubra*.

Shoe string root rot, caused by *Armillaria mellea* Vahl., reported from Washington in Lewis County. Earliest report June 27.

White root rot, caused by *Polyporus dryadeus* Fr., reported from Minnesota in Ramsey County on *Q. macrocarpa*. Earliest report July 31.

Soft heartwood rot, caused by *Polyporus obtusus* Berk., reported from Minnesota on *Q. rubra*.

White heart rot, caused by *Fomes everhartii* (E. & Q.) Schrenk, reported from Minnesota in Ramsey County. Earliest report August 10.

Mildew, caused by *Microsphaera alni* (Wal.) Wint., found in Athens and Wayne Counties, Ohio.

Twig blight, caused by *Botryodiplodia ravenelli*, occurred in Ohio.

Shot hole, caused by *Cylindrosporium quercus* Sorok., occurred in Ohio.

Rust, caused by *Cronartium cerebrum* (Pk.) Hedgc. & Long, general in southern part of Georgia, injury ranging from 5 to 25%. Estimated loss about 1%. Earliest report April 1.

Leaf blight, caused by *Gnomonia veneta* (S. & S.) Kleb. (*Gloeosporium nervisequum* (Fckl.) Sacc.), present in New York, New Jersey (on *Q. prinos* and *Q. alba*) and D. C. (on *Q. alba*).

Diplodia longispora C. & Ell., present in Pennsylvania on *Q. prinos*. (J.F.C.)

Canker, caused by *Nectria cinnabarina* Fries., present in Pennsylvania on *Q. rubra*. (J.F.C.)

Dothiorella quercina (C. & Ell.) Sacc., present in Pennsylvania. (J.F.C.)

PINE, White (Pinus strobus)

White pine blister rust, caused by *Cronartium ribicola* Fisher.

"*STATUS OF BLISTER RUST CONTROL IN 1919*

(Prepared by S. B. Detwiler, Office of Forest Pathology)

"White pine blister rust has not been found in the Rocky Mountain and Pacific Coast states, after three years of scouting. In the eastern white pine area it is extending its range and increasing in degree of infection. In Wisconsin and Minnesota, infected Ribes (currants and gooseberries) have been found over an area approximately 150 miles long and 100 miles wide. At an interstate conference held at St. Paul in October, 1919, local control of the disease on the same basis as now practiced in England, was decided upon as the policy for the future. With general blister rust infection at the eastern and the western extremities of the range of *Pinus strobus*, it is only a question of time until the disease reaches Michigan, Pennsylvania, and other parts of the eastern white pine area in which no infections on native growth have as yet been found.

"No evidence of the white pine blister rust has been found in the Pacific Coast and Rocky Mountain States, although fourteen men continued to scout in 1919 as during the past three years. The work has consisted of locating and inspecting the blister rust hosts that have entered this territory from a region where the disease was present; scouting wild plants for the disease; and searching for violations of the Federal quarantine against shipping Ribes and five-leaved pines west of the Great Plains. Several violations of this quarantine were found. If the sugar pine and western white pine are to be kept free from this disease, five-leaved pines, and currant and gooseberry plants from infected regions must be kept out of the West, as provided by the quarantines in both the United States and Canada.

"A single diseased shipment of either pine or Ribes may result in enormous losses in the far West, both to private and Government holdings. The sixty-five species of wild Ribes native to the western half of North America would afford unbroken chains for the dissemination of blister rust. The bushes are so numerous in the white pine and sugar pine regions that the cost of eradication would probably be prohibitive in most localities. A native rust found on Ribes in Colorado, Utah, New Mexico, Arizona, California and Nevada proved to be the piñon blister rust (Cronartium occidentale). This is a peridermium which has for its alternate host the piñon or nut pines.

"Blister rust infection on pine in the northeastern States is increasing rapidly. In a 41-acre pine lot at Littleton, New Hampshire, containing a total of 5442 white pines averaging 6 inches in diameter, 3014, or 55% of the trees are infected with the rust. This infection is entirely due to wild gooseberries, which average 30 bushes (199 feet of leaf-bearing stem) per acre. The oldest infection found on pine in this region is estimated to have started in 1906, or 13 years ago. Strip surveys a rod wide, totaling 22-5/8 miles in length, recently were run out north, south, east and west from this pine lot across the surrounding country. Out of 2896 pine trees growing on these strips, 25.5% have been attacked by the disease. In addition, 1461 pines were inspected in 33 widely scattered quarter-acre plots, and 41% were found infected. Thus, in an area 8 miles wide and 9 miles long, a total of 9,799 pines were examined and 4,359 trees, or 44%, found diseased.

"Since the strip lines give a fair average, it appears that at least one-fourth of the pines in 72 square miles covered by the survey in the Littleton region are infected with blister rust. On another strip line 30-7/8 miles long, run from Lisbon to Woodsville and Piermont, N. H., 2.4% of 6,758 trees were diseased. This shows that infection is progressing rapidly, and that pine owners should lose no time in destroying currant and gooseberry bushes in the vicinity of their pines.

"Blister rust control through destruction of currant and gooseberry bushes has been tried experimentally since 1916, in cooperation with the New England States and New York. The results show that effective control of the disease is possible, and that cost is low in comparison with the value of the pine protected. On four control areas from which currant and gooseberry bushes were removed in 1916 and early in 1917, no new pine infections were found this year. Under trained supervision, unskilled laborers quickly attain efficiency in finding and destroying 95% or more of the wild currant and gooseberry bushes the first time over the area. In 1919, 1070 accurate checks were made to determine thoroughness of eradication by the crews. The crews made 642 checks, in which 246.254 bushes, or 96.4%, were uprooted in the first working, 8095 bushes the second working, 905 the third, 125 the fourth, and 10 the fifth time over the ground. On eight areas worked in previous years, totaling 2485 acres, 155,059 wild Ribes (95.5%) were found in the original working and only 7,310 bushes, (of which 3121 were sprouts and seedlings) were found in going over the areas in 1919. On an acre basis, 62 wild Ribes bushes were destroyed in the first working, 2 bushes were missed, and 1 new plant developed from seeds or sprouts.

"Where only 87% of the wild Ribes bushes were removed in the first working, these bushes bore 96.6% of the leaves. The leaves on 2194 bushes were counted in this test. In the first working 94,429 leaves were destroyed, and in three subsequent workings, only 3094 leaves were found. Measurements of the annual growth of 836 gooseberry bushes show an average height growth of 5 inches per year for 4 years. Other counts show that less than 5% of the gooseberry bushes produce fruit, even in favorable crop years. Intensive study of Ribes seedlings on small plots show that they summer kill as well as winter kill, so that only a very small percentage live through the first year.

"Results of scientific studies by the Office of Forest Pathology on the distribution of sporidia and the distance that infection has actually occurred upon pines from known infected Ribes, indicate that the Ribes-free zone should be, under average conditions, 200 to 300 yards in width. Tests of the longevity of the sporidia showed that they remained viable for a period of less than ten minutes where the humidity was 90. Cultivated black currant (*Ribes nigrum*) is especially susceptible to the blister rust, and the large volume of sporidia produced on the leaves of this species may cause severe pine infection to a greater distance than 300 yards. A plantation of approximately 3000 cultivated Ribes, containing about 600 bushes of black currants, has apparently infected native pines to a distance of 1.6 miles from the bushes. In another infection area where there were only 6 cultivated Ribes, 3 of them black currants, there was no appreciable amount of pine infection beyond 130 feet from the Ribes.

"The cost per acre of Ribes eradication is low. The state crews eradicated Ribes from 252,114 acres in 1919, at an average cost of 42 cents per acre for labor, or 54 cents per acre including supervision. In 1918 the average cost, including supervision, was 66 cents per acre on 135,239 acres. This reduction in cost was accomplished through the application of ecological knowledge in locating wild Ribes in regions where they are not evenly distributed. By this means, the average cost per acre in New England was reduced from 44 cents in 1918 to 24 cents this year.

"Three years' experimental work in spraying Ribes with various chemicals shows that dip oil and fuel oil are effective in killing Ribes. It appears that this method will greatly reduce cost of eradicating Ribes where the wild bushes are very numerous.

"In Massachusetts, local cooperators furnished $1075 for cooperative eradication of Ribes. The sympathetic attitude of the public toward blister rust control is evidenced by the fact that in New Hampshire 21,191 cultivated Ribes were destroyed, and compensation was asked by only three owners. Towns, associations, and individuals in New York, New Hampshire and Massachusetts subscribed $21,642 for cooperative control. The necessity for developing local control of the blister rust is apparent from the rate of increase of the disease in the native pine stands, and the demonstrated practicability of Ribes eradication fully justifies pine owners in undertaking this work on a large scale."

PINE (Pinus spp.)

Rusts, caused by *Cronartium filamentosum* (Pk.) Hedge. & Long, and by *C. cerebrum* (Pk.) Hedge. & Long, were reported respectively from Washington (earliest report Aug. 6 in Stevens Co.) and from Georgia. (Generally in the southern section of state. Injury ranged from 5-25% with a 1% estimated loss. Earliest report April 1 - weather favorable to the disease.)

Mistletoe (*Razoumofskya* sp.) was reported by Dr. Heald and Mr. Dana from Washington in Stevens County, earliest report August 5.

Leaf cast, caused by *Lophodermium pinastri* (Schr.) Chev., was reported from Washington in Pierce County, April 1.

Canker, caused by *Cenangium ferrugineosum* Fr. (*C. abietis* (Pers.) Rehm.), occurred in Ohio on the white pine.

Blight, non-parasitic, reported from Connecticut. Apparently less than usual. The type was mostly that of sun scorched. Reported from Fairfield, Litchfield and New Haven Counties.

A root rot, cause undetermined, is under investigation in Ohio. Found in Wayne County.

PINE, Austrian (Pinus austriaca)

Twig blight, caused by Physalospora cydoniae Arnaud (Sphaeropsis malorum Berk.), reported from Connecticut. Of rare occurrence, being found only in Fairfield, New London and Washington Counties. According to Dr. Clinton it apparently follows winter injury to the young twigs.

Die-back, caused by Diplodia sp., was reported by Dr. Mel. T. Cook as having been very destructive to the trees during the year in New Jersey.

Winter injury in Connecticut killed the young buds and twigs along the shore, especially in exposed places. Reported from Fairfield, New London and Washington Counties.

PINE, Scotch (Pinus sylvestris)

Rust, caused by Cronartium comptoniae Arth., occurred in Ohio.

Phoma geniculata (B. & Br.) Sacc., present in New Hampshire. (J. F. C.)

POPLAR (Populus spp.)

Rust, caused by Melampsora spp., reported from Oklahoma (Present in Garvin, Jefferson, Logan, Oklahoma and Payne Counties. Earliest report in August. Considerable moisture made conditions favorable for the disease.), Ohio, Iowa (Common), Minnesota (Earliest report September 10), and New Mexico. (The leaves were badly affected. The disease was general over the entire county of Dona Ana.)

Canker, caused by Cytospora chrysosperma (Pers.) Fr., was reported from Colorado and New Mexico. Abundant and severe in Colorado. In some sections of the state at least 50% of the trees were lost. Since the poplar is an important tree in Colorado both for shade purpose and for wind breaks, this disease is a serious menace. Canker was moderately severe in Bernalillo and Dona Ana Counties in New Mexico, where the estimated loss was about 2%. In Colorado the earliest report was in May and in July for New Mexico.

Twig blight, caused by Dothichiza populea Sacc. & Briard, was reported from New Jersey, (Occasional and of some importance) and Minnesota (Found in Steele County June 17).

Leaf spot, caused by Marssonia populi (Lib.) Sacc. and Marssonia castagnei (D. & M.) Sacc., reported respectively from New Jersey (Common) and Ohio.

Powdery mildew, caused by Uncinula salicis (D.C.) Wint., reported from Lake County, Minnesota.

Phoma populi Pk. reported from Minnesota. Moderately severe in Rice County.

Fusicladium radiosum (Lib.) Lind, present in Maine on P. alba. (J. F. C.)

SEQUOIA (Sequoia washingtoniana)

Botrytis douglassi Tub. occurred in Ohio.

Cercospora sequoiae E. & E. present in D. C. (J. F. C.)

SUMAC (Rhus spp.)

Leaf spot, caused by Phyllosticta sp., reported from Stevens County, Minnesota, July 28 on Rhus glabra.

Septoria leaf spot, caused by Septoria irregularis Pk., reported from Minnesota, present in Hennepin (Earliest report July 26) and Ramsey Counties.

Rust, caused by Pileotaria toxicodendron Arth., reported from Minnesota, earliest report September 4, in Ramsey County.

Canker, thought to be caused by Physalospora cydoniae Arnaud (Sphaeropsis malorum Berk.), occurred in Ohio.

SYCAMORE (Platanus spp.)

Anthracnose, caused by Gnomonia veneta (S. & S.) Kleb. (Gloeosporium nervisequum (Fckl.) Sacc.), reported from New Jersey, Maryland, Georgia, Oklahoma, Arkansas, Ohio, Iowa, Nebraska and Kansas. Except for Ohio and Iowa the disease was quite general. Especially injurious in Arkansas; at times destructive in New Jersey nurseries. The use of Bordeaux mixture in Oklahoma gave good results.

Earliest reports: April, Arkansas; May 1, Georgia; June 9, Ohio; and July Oklahoma.

TULIP TREE (Liriodendron tulipifera)

Leaf spots, caused by Phyllosticta liriodendrica Cke., present in Maryland (J. F. C), and Gloeosporium liriodendri E. & E., present in Ohio. (J. F. C.)

UMBRELLA TREE (Melia sp.)

Texas root rot, caused by Ozonium omnivorum Shear, reported from Texas by Dr. Taubenhaus as prevalent, producing an estimated loss of about 10%. Weather conditions favorable.

WALNUT (Juglans sp.)

Leaf spot, caused by Marssonia juglandis (Lib.) P. Magnus, present in Pennsylvania. (J. F. C.)

WILLOW (Salix spp.)

Leaf rust, caused by Melampsora spp., was reported from Connecticut, (Earliest report September 18, New Haven County), Ohio (M. bigelowi Thüm), Minnesota (M. bigelowi Thüm reported on Salix longifolia and Salix sp.. Earliest report Kanabec County, May 12 on the stem of the plant. Found in Hennepin, Washington, Chisago and Kanabec Counties), and Washington (Present in Yakima County).

Rust, caused by Melampsora salicis albae Kleb., according to Dr. Melhus, was common in Iowa.

Powdery mildew, caused by Uncinula salicis (D. C.) Wint., reported from Ohio, Minnesota (A trace in Lake County), Iowa (Common), and Washington (Moderately severe in Pierce County).

Tar spot, caused by Rhytisma salicinum Fries., was reported from Ohio and Minnesota (No doubt quite general, earliest report from Washington County August 3).

Wood rot, caused by Daedalea confragrosa (Bolt.) Pers., was reported from Minnesota.

DISEASES OF ORNAMENTALS

AMPELOPSIS sp.

Leaf spot, caused by Guignardia bidwellii (E) V. & R., was reported from New Jersey, Rhode Island (J. F. C.), Connecticut, and Minnesota, where it was found in several of the southeastern counties.

Powdery mildew, caused by Uncinula necator (Schw.) E. & E. (U. ampelopsidis Peck.), reported from Minnesota, of local occurrence.

ASTER (Aster sp.)

Fusarium wilt, caused by Fusarium sp. The range for 1919 extended across the northern half of the United States from the Atlantic to the Pacific Coasts. In 1918 but two states reported its occurrence while in 1919 there were eight noting its presence,- Connecticut (Fairfield and New Haven Counties), Ohio (Franklin, Miami and Wayne Counties), Indiana (Tippecanoe County), Minnesota (Goodhue County), Kansas (Crawford County), North Dakota (Cass County), Nevada (Washoe County), and Washington (King County).

The disease was severe in Kansas (60% injury). In Nevada all the plants in the bed were practically killed. In Minnesota there was slight injury ranging from 2-5%. Earliest reports were July 11, Kansas; July 22, Connecticut; August, Ohio; July 21, Minnesota; August 1, Washington.

Powdery mildew, caused by Erysiphe cichoracearum D. C. (E. asterum Sch.), reported from Rice County, Minnesota on July 19.

Yellows, cause undetermined, more or less prevalent every year in New Jersey. One occurrence reported from Minidoka County, Idaho.

Rhizoctonia was reported as affecting asters in King and Pierce Counties, Washington. Earliest report July 7.

An undetermined disease attacked the asters in Crawford County, Kansas, and caused moderate injury.

BEGONIA (Begonia sp.)

Root knot, caused by Heterodera radicicola (Greef.) Müller., reported from Wayne County, Ohio and Marion County, Indiana (April 14).

Leaf spot, cause undetermined, reported from Pullman, Washington.

BOX (Buxus sp.)

Fusarium roseum Lk. present in North Carolina (J. F. C.)

CARNATION (Dianthus caryophyllus)

Rust, caused by Uromyces caryophyllinus (Sch.) Wint., reported from Connecticut (New Haven County), New Jersey (common), Oklahoma (Payne County), Ohio (Crawford, Fairfield and Franklin Counties), Minnesota (Ramsey County), and Nevada (Washoe County), apparently not serious. Appeared on greenhouse stock in Oklahoma and Minnesota. In Connecticut the Pink and White Enchantress were rusted.

Stem rot, caused by Corticium vagum B. & C., common in New Jersey, but not serious.

Stem rot, caused by Botrytis sp., occurred in Ohio.

Root knot, caused by Heterodera radicicola (Greef.) Müller, a trace in Grayson County, Texas.

CHRYSANTHEMUM (Chrysanthemum hortorum)

Powdery mildew, caused by Erysiphe cichoracearum D. C. (Oidium chrysanthemi), reported from South Carolina (common, 40% injury, 5% estimated loss), Ohio (Wayne County), Minnesota (Kanabec and Ramsey Counties - earliest report Nov. 1), and Washington (Erysiphe species questioned, earliest report July 30 - slight appearance in Snohomish County).

Rust, caused by Puccinia chrysanthemi Roze., reported from Grays Harbor County, Washington, June 11 - unimportant.

Ray blight, caused by Ascochyta chrysanthemi Stev., reported from Oconee, Orangeburg and Richland Counties, South Carolina.

Sooty mold, caused by Fumago sp., reported from Texas. Unimportant.

Leaf blight, caused by Cylindrosporium chrysanthemi E. & D., reported from Connecticut in New Haven County.

Leaf spot, caused by Septoria chrysanthemella Cav., reported from Navarro County, Texas.

Mosaic reported from Ohio.

CLEMATIS (Clematis sp.)

Root knot, caused by Heterodera radicicola (Greef.) Müll., reported from Washington. Earliest report March 15 at Spokane.

DAHLIA (Dahlia sp.)

Blight, cause unknown, reported by C. H. Philpott to have been found in Henry and Jasper Counties, Missouri, and by C. W. Hungerford from Jefferson County, Idaho.

EVONYMUS (Evonymus sp.)

Leaf spot, caused by Exosporium concentrichum (Heald) Wolf., was common in Texas.

Powdery mildew, caused by Microsphaera evonymi (D. C.) Sacc., reported from Minnesota. Earliest appearance August 10.

GERANIUM (Geranium sp.)

Leaf spot, caused by Bacterium erodii Lewis, reported from Ohio.

Downy mildew, caused by Plasmopara geranii (Peck.) Berlese and de Toni., reported from Iowa. Found at Stacyville June 12 on a wild species.

Powdery mildew, caused by Sphaerotheca humuli (D. C.) Burr., reported on G. maculatum June 18 from Ramsey County, Minnesota.

Rhizoctonia, caused by Rhizoctonia sp., reported from Pierce County, Washington. Earliest report April 11.

Rust, caused by Uromyces geranii (de C.) Otth. & Wart., reported on G. maculatum June 4 from Mower County, Minnesota. Also found in Hennepin and Ramsey Counties.

"Dropsy" (physiological) reported from Wayne County, Ohio.

GOLDEN ROD (Solidago sp.)

Powdery mildew, caused by Erysiphe cichoracearum D. C., reported on S. canadensis August 10 from Ramsey County, Minnesota, also found in Chisago County.

Rust, caused by Puccinia caricis-solidaginis Arth. on S. canadensis, reported from Anoka, Isanti, Hennepin, Ramsey, Todd, Wadena and Washington Counties, Minnesota. Earliest report June 20; on S. serotina reported from Chisago County, Minnesota, September 5.

GOLDEN GLOW (Rudbeckia laciniata)

Powdery mildew, caused by Erysiphe cichoracearum (D. C.) (E. lamprocarpa Kickx.), reported August 18 as moderately severe in McLeod County, Minnesota.

HOLLY (Ilex sp.)

Leaf spot, caused by Phyllosticta opaca E. & E., present in Pennsylvania. (J. F. C.)

HOLLYHOCK (Althea rosea)

Root rot, caused by Ozonium omnivorum Shear, reported from Texas. Prevalent, estimated loss about 10%.

HONEYSUCKLE (Lonicera sp.)

Powdery mildew, caused by Microsphaera alni (Wal.) Salm., was reported from Minnesota on Lonicera sempervirens (earliest report July 31) and on Lonicera tatarica (earliest report June 28 in Ramsey County).

HYDRANGEA (Hydrangea sp.)

Leaf spot, caused by Septoria hydrangeae Bizz., occurred in Ohio.

IRIS (Iris sp.)

Leaf spot, caused by Didymellina iridis (Desm.) H. (Heterosporium gracile (Wallr.) Sacc.), reported from Connecticut, Ohio and Minnesota.

Rot, caused by Botrytis sp., reported June 6 from King County, Washington.

Blight, cause undetermined, reported July 30 from Snohomish County, Washington.

IVY, English (Hedera sp.)

A leaf spot, cause unknown, reported from Washington. Earliest report July 24 in Pierce County, moderately severe.

KALMIA (Kalmia sp.)

Leaf spot, caused by Phyllosticta sp., present in New Jersey. (J. F. C.)

LARKSPUR (Delphinium sp.)

Powdery mildew, caused by Erysiphe polygoni D. C. (E. communis Grev.), reported in August from Ramsey County, Minnesota.

LILAC (Syringa spp.)

Blossom blight, cause bacterial, reported from Delaware.

Frost injury reported from Washington. Moderately severe in Okanogan and Whitman Counties. Earliest report June 18.

Leaf spot, caused by Phyllosticta halstedii E. & E., reported from New Jersey, of common occurrence.

Powdery mildew, caused by Microsphaera alni (Wal.) Salm., reported from Connecticut, (moderately severe in New Haven and New London Counties), New Jersey (very common throughout the state), Delaware, Maryland, South Carolina (common), Oklahoma (local), Ohio (more prevalent than usual, reported from 19 counties), and Iowa (very common).

PEONY (Paeonia sp.)

Leaf blotch, caused by Cladosporium paeoniae Pass., reported from Connecticut and Minnesota. Local in both states.

Blight, caused by Botrytis sp., reported from Ohio (Clinton, Franklin, Montgomery and Tuscarawas Counties) and Minnesota.

Mosaic (non-parasitic) reported from Ohio and Washington.

PHLOX (Phlox sp.)

Powdery mildew, caused by Erysiphe cichoracearum D. C., reported from Connecticut. Present in Fairfield and New Haven Counties. One observer wrote that the colored varieties were badly affected while the white varieties were free from the disease.

Powdery mildew, caused by Sphaerotheca humuli (D.C.) Burr., occurred in Ohio.

POPPY (Papaver sp.)

Blossom blight, cause uncertain, reported May 12 from King County, Washington.

PRIVET (Ligustrum sp.)

Anthracnose, caused by Glomerella cingulata (Stoneman) Sp. and von S. (Gloeosporium cingulatum Atk.), was reported from Texas (prevalent, estimated loss about 1% - reported from Bell County), Ohio and Indiana.

Root rot, caused by Ozonium omnivorum Shear, reported from Ellis County, Texas. Estimated loss about 1%.

Leaf spot, caused by Exosporium concentricum Heald & Wolf, reported from Harris County, Texas.

Winter injury, caused by low temperature and snow, was very much less in Ohio than what usually occurs.

ROSE (Rosa spp.)

Powdery mildew, caused by Sphaerotheca pannosa (Wal.) Lev., reported from Connecticut, New Jersey, Delaware, Virginia, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Oklahoma, Texas, Arkansas, Ohio, Indiana, Minnesota, Missouri, Nebraska, Colorado, Nevada, Idaho, Washington and Hawaii. The disease was more prevalent than in 1917 and 1918, of common occurrence in all the states reporting it except in Nebraska and Colorado. Considerable injury occurred in New Jersey, Delaware, South Carolina, Georgia, Texas, Oklahoma, Arkansas and Ohio. The wet weather conditions which prevailed in the states reporting, were favorable except Colorado where dry conditions were experienced.

Dates of appearance:

1917		1918		1919			
Mar.	- La.	Mar.	- La.	Feb. 19	- Wash.	May 9	- Fla.
May	- Miss.	Mar. 29	- Miss.	Mar.	- La.	May 17	- Okla.
June	- Okla.	July 13	- Mo.	Apr. 1	- Ga.	June 3	- Ohio
July 27	- Ohio	Oct.	- Okla.	May	- Ark.	June 26	- Colo.
Aug. 16	- N. Y.			May	- S. Car.	June 28	- Minn.
				May 8	- Ala.	July 10	- Conn.

Crimson Rambler and ramble varieties were the most susceptible in Oklahoma and Indiana. In Connecticut the disease was worse on the Dorothy Perkins. The Killarney was also quite susceptible in Indiana.

In Connecticut a conspicuous white felt was formed on the hips, and the blossom development was somewhat interfered with.

Lime-sulfur was reported to have given fair results in South Carolina.

Black spot, caused by Diplocarpon rosae Wolf. (Actinonema rosae (Lib.) Fr.), was reported of general occurrence in the following states: Connecticut, New Jersey, Delaware, South Carolina, Florida, Alabama, Mississippi, Louisiana, Texas, Arkansas, Ohio, Indiana, Minnesota and Washington. In Oklahoma only a trace appeared. The per cent of injury in South Carolina amounted to about 90%, resulting in an estimated loss of 3% of the blooms. In Delaware there was a 3%, and in Arkansas a 2%, injury to the plants. Although the injury ran high in Louisiana the loss was very slight. The disease was present to a considerable extent in a greenhouse in Indiana. Moist weather conditions were favorable to the disease in South Carolina, Florida and Arkansas.

Dates of appearance:

1919			
Apr. 1	- Ohio	June	- S. Car.
Apr. 26	- Ala.	June 6	- Wash.
May 21	- Fla.	June 24	- Minn.
May 28	- La.	Sept.	- Okla.

It was noted in Connecticut that the tender out-of-door plants and those grown in greenhouses seemed more susceptible to the disease than the more hardy varieties.

Rusts, caused by Phragmidium spp., reported from Connecticut, Arkansas, Ohio, Minnesota, Iowa, Nevada and Washington, of common occurrence in all states reporting except in Ohio where it is only occasionally met. It appeared May 7 in Minnesota, May 26 in Washington and June 19 in Connecticut.

Crown gall, caused by Bacterium tumefaciens S. & Town., reported from Connecticut (caused a moderate amount of damage in New Haven and Middlesex Counties), New Jersey (frequent and sometimes injurious), Ohio (present in Richland County), Minnesota (present in Itasca County Aug. 2) and Washington (earliest report Sept. 10 - present in Skagit County).

Anthracnose, caused by Gloeosporium rosae Hals., reported from New Jersey (common, not serious) and Ohio.

Bud rot, caused by Botrytis sp., reported from Washington, present in King and Pierce Counties. Earliest report June 18.

Cane blight, caused by Leptosphaeria coniothyrium (Fckl.) Sacc., reported from New Jersey. Common, produces serious injury at times.

Leaf spot, caused by Phyllosticta rosicola Mass., reported from New Jersey. Abundant.

Winter injury, reported from Washington in Thurston and Whitman Counties.

Frost blister, quite general in Washington. First report May 14.

Canker, cause undetermined, reported from Washington. Occurred in Snohomish County, earliest report June 5.

SALVIA (Salvia sp.)

Cladosporium aphidis Thüm. reported from Ohio.

SNAPDRAGON (Antirrhinum majus)

Rust, caused by Puccinia antirrhini Diet. & Holw., was reported from Pennsylvania, Ohio, Missouri, Nebraska and Washington. In Pennsylvania the amount of injury ranged from slight to very severe and in Missouri and Nebraska those grown in greenhouses were injured considerably.

Anthracnose, caused by Colletotrichum sp., was reported from Pennsylvania (general, injury ranged from 5-10% - earliest reported appearance July in Luzerne County).

SUNFLOWER (Helianthus spp.)

Powdery mildew, caused by Erysiphe cichoracearum D. C., was reported from Minnesota on H. annuus, H. hirsutus and H. maximiliani.

Rust, caused by Puccinia helianthi Schw., reported from New Jersey, Oklahoma, Minnesota and California. In Minnesota found on H. annuus and H. maximiliani.

Downy mildew, caused by Plasmopara halstedii (Farl.) B. & de T., occurred in Iowa.

Wilt, caused by Sclerotinia sp., reported from Pierce County, Washington. Moderately severe.

SWEET PEA (Lathyrús odoratus)

Powdery mildew, caused by Erysiphe polygoni D. C., reported from Delaware, South Carolina and Minnesota. Of common occurrence in Delaware. Local in South Carolina. Earliest reported appearance in Minnesota, Aug. 19.

Pod and root rot, caused by Thielavia basicola (B. & Br.) Zopf., reported September 18 from Hamilton County, Ohio.

Stem and root rot, caused by Fusarium sp., was severe in Dodge County, Minnesota.

Streak, caused by Bacillus lathyri M. & T., was very common in Delaware, producing a 50-60 crop injury.

Mosaic, cause undetermined, reported from Delaware, 1-2% crop injury.

SYRINGA (Philadelphus sp.)

Phoma landeghemiae (Nitsch.) Sacc., present in New York. (J. F. C.)

TULIP (Tulipa sp.)

Leaf spot and blight, caused by Botrytis sp., which followed insect injury was reported from King and Pierce Counties, Washington. Moderately severe. Earliest appearance May 2.

White rot, caused by Sclerotinia fuckeliana (De.B.) Fckl., occurred in Ohio.

White spot, cause undetermined but thought to have been caused by smoke or late frost, appeared in Connecticut in early May. There was one report of a serious nature and several of slight injury to the blossoms, which were covered with small white spots. The leaves were less affected. A late frost, which occurred in May, might have been the cause. The worst case though was from smoke of a nearby steel converter.

VERBENA (Verbena sp.)

Powdery mildew, caused by Erysiphe cichoracearum D. C., was reported from Minnesota on Verbena hastata and Verbena urticaefolia. Earliest report July 24. Found in Hennepin, Anoka, Ramsey, McLeod, Chisago and Washington Counties.

VIOLET (Viola spp.)

Leaf spot, caused by Phyllosticta violae Desm., reported from Florida (occasionally found, also caused by Cercospora violae Sacc., which is common in Florida.

Rust, caused by Puccinia violae (Schum.) D. C., was reported June 26 from Ramsey County, Minnesota on Viola pubescens; and Nigredo pedatata (Schw.) Arth., was reported May 30 from Hennepin County, Minnesota on Viola sororia.

Root knot, caused by Heterodera spp., was reported May 17 from Bryan County, Oklahoma.

Root rot, caused by Sclerotium rolfsii Sacc., was abundant in Alabama.

DISEASES OF MISCELLANEOUS PLANTS

CASTOR BEAN (Ricinus communis)

Root rot, caused by Ozonium omnivorum Shear, reported from Texas (epidemic in Cameron and Hildago Counties).

COFFEE (Coffea sp.)

Black root rot, caused by Rosellinia sp., was reported present in Porto Rico by J. Matz. Occurred in spots, injury small except where individual trees were killed.

DANDELION (Taraxacum taraxacum)

Rust, caused by Puccinia taraxaci Plow., of general prevalence in Minnesota. Twelve counties reporting its occurrence, earliest report May 30 in Ramsey County.

Powdery mildew, caused by Sphaerotheca humuli var. fuliginea (Schlect.) Lahn. (Sphaerotheca castagnei), reported from Minnesota (Hennepin, Isanti, Lake, McLeod and Ramsey Counties, earliest report June 9 in Ramsey County).

LACTUCA PULCHELLA

Rust, caused by Puccinia hemisphaerica (Peck.) E. & E., reported from Hennepin, Isanti and Ramsey Counties, Minnesota. Earliest report June 18.

LEPIDIUM EPATALUM

Downy mildew, caused by Peronospora parasitica (Pers.) DeBary, was reported to have been very common in Iowa.

NETTLE (Urtica dioica)

Rust, caused by *Puccinia caricis* (Schum.) Rebent, reported from Freeborn, Hennepin, Mower and Ramsey Counties, Minnesota. Earliest reported appearance May 30.

SHEPHERD'S PURSE (Capsella bursa-pastoris)

White rust, caused by *Albugo candida* (Pers.) Roussel, was reported from Mower and Ramsey Counties, Minnesota to have been moderately severe.

Mr. E. A. Siegler,
Office of Fruit Diseases,
Bureau of Plant Industry,
U. S. Department of Agriculture,
Washington, D. C.

DUPLICATE

THE PLANT DISEASE BULLETIN

Issued By

THE PLANT DISEASE SURVEY

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SUPPLEMENT 12

Crop Losses from Plant Diseases in the United States in 1919.

July 1, 1920

BUREAU OF PLANT INDUSTRY

UNITED STATES DEPARTMENT OF AGRICULTURE

PLANT DISEASE SURVEY

1919

G. R. Lyman, Pathologist in Charge.

R. J. Haskell, Asst. Pathologist. G. H. Martin, Jr., Asst. Pathologist.

List of Collaborators of the Plant Disease Survey who have made the principal contribution to the 1919 annual summary.

It should be understood that many other collaborators and pathologists have assisted in gathering data within the states but the following list includes those who actually furnished state reports to the Washington office.

Alabama	Dr. G. L. Peltier
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Arkansas	Dr. J. A. Elliott
	Prof. H. R. Rosen
Colorado	Prof. J. G. Leach
Connecticut	Dr. G. P. Clinton
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	Prof. H. S. Jackson
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New Mexico	Prof. L. H. Leonian
New York	Dr. Chas. Chupp
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North Dakota	Prof. H. L. Bolley
Ohio	Prof. A. D. Selby
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Oklahoma	Prof. C. D. Learn
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Utah	Dr. G. R. Hill, Jr.
Vermont	Dr. B. F. Lutman
	Prof. A. H. Gilbert
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Washington	Dr. F. D. Heald
	Mr. B. F. Dana
	Mr. A. M. Frank
West Virginia	Dr. N. J. Giddings
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Wisconsin	Dr. R. E. Vaughan
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THE PLANT DISEASE BULLETIN

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THE PLANT DISEASE SURVEY

Supplement 12 July 1, 1920.

CROP LOSSES FROM PLANT DISEASES
IN THE UNITED STATES IN 1919

Prepared by the Office of Plant Disease Survey.

BUREAU OF PLANT INDUSTRY
UNITED STATES DEPARTMENT OF AGRICULTURE
Washington, D. C.

CROP LOSSES FROM PLANT DISEASES IN THE UNITED STATES

IN 1919.

Supplement 12 1920

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SOURCES OF INFORMATION

The data upon which the subsequent summaries are based was obtained from the following sources:

1. Collaborators of the Plant Disease Survey, as listed on the opposite page.

2. Records of the 1919 cereal disease survey, conducted by the Office of Cereal Investigations, U. S. Department of Agriculture.

3. Crop disease specialists in the Bureau of Plant Industry.

4. Reports and records of the Plant Disease Survey.

Collaborators prepared their estimates in most cases with the assistance of other pathologists associated with them and sent them to the Washington office. The estimates were then compared with the results of the cereal disease survey and with all other available data and in each case what was considered to be a conservative figure was recorded. These preliminary percentage estimates were then resubmitted to collaborators and certain other pathologists for suggestions and revisions before issuing the final figures.

METHODS

In computing these losses the depredations of insects or the failure of crops because of weather factors has not been taken into account. Disease alone is considered, and the basis for computation has been the production that would have been possible if it were not for disease. In other words, the actual production is taken to represent 100% minus the sum of the percentages of loss from all diseases of the crop in question. The possible production is obtained by dividing the actual production by 100% minus the total percentage of loss from all diseases of the crop.

Thus:

$$\text{Possible production} = \frac{\text{Actual production}}{100\% - \%\text{ loss from all diseases of crop}}$$

The estimated loss from a given disease, then, is obtained by multiplying the estimated possible crop production by the estimated percentage loss from the disease, thus:

$$\text{Estimated crop loss} = \frac{\text{Actual production}}{100\% - \%\text{ loss from all diseases}} \quad \begin{matrix}\%\text{ individual}\\ \text{disease loss}\end{matrix}$$

Stated algebraically it would be as follows:

x = Crop loss, in units, from a given disease.
y = Estimated possible production if it were not for diseases.
a = Acutal crop production for the year.
b = Sum of estimated percentages of loss for all diseases of the crop.
c = Estimated percentage loss from given disease.

$$y = \frac{a}{100 - b}$$

$$x = yc$$

$$\therefore x = \frac{ac}{100 - b}$$

SYMBOLS

Certain symbols have been used frequently in the accompanying tables.

- = No data.
t = Trace. It indicates that the loss is less than 1% but data are not available for estimates beyond that. In some instances, such as the cereal smuts, where many detailed counts are available and where state estimates have been made to a fraction of a percent, t usually signifies a small fraction of 1% (less than .1% in many cases.)
+ = Loss occurred but amount not estimable. This is used (a) where a trace is given as the percentage loss; (b) when no production figures are given but when the percentages show some loss; (c) to indicate an excess. It is used in connection with most of the totals to signify that the actual loss is probably greater than that shown; and (d) in the case of leaf rusts of cereals where percentages of affected leaf area are available but where intelligent estimates of reduction in yield are impossible at this time.
*- = Occurrence but no data as to loss.
*0 = Occurrence but no loss.

WHEAT

Estimated reduction in yield of wheat due to scab (*Fusarium* sp.), leaf rust (*Puccinia triticina*), stem rust (*Puccinia graminis*), bunt (*Tilletia laevis* and *T. tritici*), loose smut (*Ustilago tritici*), and other diseases, 1919.

State	Production: 1919 Bushels (000 omitted)	Estimated reduction in yield due to diseases. Scab %	Scab Bushels (000 omitted)	Leaf rust %	Leaf rust Bushels (000 omitted)	Stem rust %	Stem rust Bushels (000 omitted)	Bunt %	Bunt Bushels (000 omitted)	Loose smut %	Loose smut Bushels (000 omitted)	Other diseases %	Other diseases Bushels (000 omitted)	All diseases %	All diseases Bushels (000 omitted)
Me.	228	-	-	-	-	-	-	-	-	-	-	-	-	-	-
N. H.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vt.	252	-	-	.5	1	2.	5	-	-	2.	5	-	-	4.5	11
Mass.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
R. I.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Conn.	-	t	+	.5	+	t	+	t	+	1.	+	.5	+	2. +	+
N. Y.	11,178	t	+	1.	113	t	+	t	+	.5	57	-	-	1.5+	170+
N. J.	1,962	4.	85	1.	21	t	+	.5	11	1.	21	1.	21	7.5+	159+
Pa.	29,055	3.	958	1.	319	t	+	t	+	2.	638	3.	953	9. +	2,873+
Del.	1,740	4.	77	2.	38	-	-	2.	38	1.5	29	-	-	9.5+	182+
Md.	10,665	5.	603	2.	241	t	+	1.	120	3.5	422	-	-	11.5+	1,386+
Va.	12,508	3.	439	3.	439	t	+	2.	292	4.	585	2.5	366	14.5+	2,121+
W. Va.	5,400	15.	1,328	3.	265	12.	1,062	2.	177	5.	443	2.	177	39.	3,452
N. C.	7,225	5.	435	5.	435	-	-	2.	174	5.	435	-	-	17.	1,479
S. C.	1,836	2.	42	5.	105	1.	21	t	+	5.	106	-	-	13. +	274+
Ga.	2,520	1.	31	8.	252	6.	189	2.	63	3.	95	-	-	20.	630
Fla.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ohio	54,440	10.	7,407	1.	741	1.	741	2.5	1,851	2.	1,481	10.	7,407	26.5	19,628
Ind.	46,020	12.	6,574	1.	548	1.	548	t	+	2.	1,096	-	-	16. +	8,766+
Ill.	65,675	18.	15,156	1.	842	1.	842	t	+	2.	1,684	-	-	22. +	18,524+
Mich.	20,237	-	-	1.	231	8.	1,850	3.	694	.5	116	-	-	12.5+	2,891+
Wis.	7,355	9.	895	1.	99	15.	1,491	t	+	t	+	1.	99	26. +	2,584+
Minn.	37,710	5.	2,618	1.	524	20.	10,475	.5	262	.5	262	1.	524	28.	14,665
Iowa	23,675	22.	7,774	1.5	530	8.	2,827	1.	353	.5	177	-	-	33. +	11,661+
Mo	57,886	6.	4,039	2.	1,346	4.	2,692	1.	673	1.	673	-	-	14. +	9,423+

State	Production 1919 Bushels (000 omitted)	Estimated reduction in yield due to disease													
		Scab		Leaf rust		Stem rust		Bunt		Loose smut		Other diseases		All diseases.	
		%	Bushels (000 omitted)	%	Bushels (000 omitted)	%	Bushels (000 omitted)	%	Bushels (000 omitted)	%	Bushels (000 omitted)	%	Bushels (000 omitted)	%	Bushels (000 omitted)
N. D.	53,613	6.	4,595	1.	766	20.	15,318	t	+	1.	766	2.	1,532	30. +	22,977+
S. D.	30,175	10.	4,050	.5	203	10.	4,050	1.	405	1.	405	3.	1,215	25.5	10,328
Nebr.	60,675	1.	722	1.5	1,084	10.	7,223	2.	1,445	1.	722	.5	361	16.	11,557
Kans.	151,001	t	+	1.5	2,681	10.	17,870	.5	893	3.	5,361	.5	893	15.5+	27,698+
Ky.	12,029	8.	1,132	2.	283	t	+	t	+	1.	142	4.	566	15. +	2,123+
Tenn.	7,290	8.	720	4.	360	1.	90	1.	90	1.	90	4.	360	19.	1,710
Ala.	1,242	t	+	5.	66	t	+	1.	13	.5	7	t	+	6.5+	86+
Miss.	504	–	–	5.	27	t	+	1.	6	2.	11	–	–	8. +	44+
La.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Texas	31,350	t	+	4.	1,370	3.	1,028	t	+	1.5	514	–	–	8.5+	2,912+
Okla.	52,640	t	+	4.	2,393	4.	2,393	t	+	2.	1,196	2.	1,196	12. +	7,178+
Ark.	3,230	t	+	3.	292	t.	+	1.5	55	2.	73	–	–	11.5+	420+
Mont.	10,729	*0	0	*0	0	*0	0	1.	108	t	+	–	–	1. +	108+
Wyo.	4,008	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Colo.	17,645	*0	0	.1	18	1.	181	1.	131	.3	54	t.	+	2.4+	434+
N.Mex.	6,100	0	0	–	–	t	+	2.	124	t	+	–	–	2. +	124+
Ariz.	1,204	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Utah	3,682	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Nev.	663	0	0	t	+	t	+	1.	7	*–	–	–	–	1. +	7+
Ida.	18,705	0	0	0	0	t	+	3.	591	1.	197	1.	197	5. +	985+
Wash.	40,100	0	0	0	0	t	+	2.	822	t	+	.5	206	2.5+	1,028+
Ore.	20,495	–	–	*0	0	*–	–	2.	423	t	+	1.	211	3. +	634+
Calif.	16,335	t	+	t	+	3.	521	2.	348	t	+	1.	174	6. +	1,043+
U. S.	940,987	5.27	59,680	1.47	16,633	6.3	71,417	.9	10,219	1.57	17,863	1.45	16,463	16.96	192,275

RYE

Estimated reduction in yield of rye due to leaf rust (*Puccinia dispersa*), stem rust (*Puccinia graminis*), scab (*Fusarium* sp.), and other diseases, 1919.

State	Production 1919 Bushels 000 omitted	Estimated reduction in yield due to disease									
		Leaf rust		Stem rust		Scab		Other diseases		All diseases	
		%	Bushels 000 omitted	%	Bushels 000 omitted	%	Bushels 000 omitted	%	Bushels 000 omitted	%	Bushels 000 omitted
Me.	–	–	–	t	+	2	–	–	–	2+	+
N. H.	–	–	–	t	+	–	–	–	–	+	+
Vt.	17	–	–	t	+	2	+	–	–	2+	+
Mass.	115	–	–	t	+	–	–	–	–	+	+
R. I.	–	–	–	t	+	–	–	–	–	+	+
Conn.	220	t	+	t	+	*–	–	–	–	+	+
N. Y.	1,932	t	+	t	+	1	20	–	–	1+	20+
N. J.	1,296	–	–	*0	0	–	–	–	–	–	–
Pa.	3,648	1	37	–	–	–	–	t	+	1+	37+
Del.	26	2	1	–	–	–	–	–	–	2	1
Md.	420	–	–	t	+	–	–	–	–	+	+
Va.	828	1	9	t	+	t	+	3	26	4+	35+
W. Va.	260	–	–	0	0	*–	–	–	–	+	+
N. C.	810	–	–	–	–	–	–	–	–	–	–
S. C.	170	2	3	–	–	–	–	–	–	2	3
Ga.	294	5	15	*0	0	–	–	–	–	5	15
Fla.	–	–	–	–	–	–	–	–	–	–	–
Ohio	1,886	1	19	–	–	–	–	1	19	2	38
Ind.	5,320	1	54	t	+	–	–	–	–	1+	54+
Ill.	4,125	–	–	–	–	t	+	t	+	+	+
Mich.	13,500	1	138	–	–	t	+	1	138	2+	276+
Wis.	8,295	1	86	0	0	0	0	2	171	3	257
Minn.	7,830	t	+	–	–	–	–	1	79	1+	79+
Iowa	1,113	1	11	0	0	–	–	–	–	1	11
Mo.	720	t	+	–	–	–	–	t	+	+	+

State	Production 1919 Bushels 000 omitted	Estimated reduction in yield due to disease									
		Leaf rust		Stem rust		Scab		Other diseases		All diseases	
		%	Bushels 000 omitted	%	Bushels 000 omitted	%	Bushels 000 omitted	%	Bushels 000 omitted	%	Bushels 000 omitted
N. D.	15,560	1	160	-	-	-	-	2	321	3	481
S. D.	6,500	t	+	-	-	-	-	3	201	3+	201+
Nebr.	6,650	-	-	-	-	-	-	t	+	+	+
Kans.	2,520	t	+	-	-	-	-	t	+	+	+
Ky.	744	t	+	0	0	-	-	1	8	1+	8+
Tenn.	279	1	3	*-	-	t	+	-	-	1+	3+
Ala.	38	1	1	t	+	-	-	2	+	3+	1+
Miss.	-	-	-	t	+	-	-	-	-	+	+
La.	-	-	-	10	+	t	+	-	-	10+	+
Texas	119	1	1	t	+	-	-	-	-	1+	1+
Okla.	350	*0	0	t	+	3	11	-	-	3+	11+
Ark.	28	1	+	*0	0	-	-	2	1	3	1
Mont.	-	-	-	-	-	-	-	-	-	-	-
Wyo.	252	*0	0	1	3	-	-	-	-	1	3
Colo.	1,258	t	+	2	26	-	-	t	+	2+	26+
N. Mex.	-	-	-	-	-	-	-	-	-	-	-
Ariz.	-	-	-	t	+	t	+	-	-	+	+
Utah	126	-	-	t	+	2	3	-	-	2+	3+
Nev.	-	-	-	*0	0	2	-	-	-	2	-
Ida.	135	-	-	t	+	-	-	-	-	+	+
Wash.	240	-	-	1	2	2	5	-	-	3	7
Ore.	532	*-	-	*0	0	0	0	-	-	t	+
Calif.	-	t	+	t	+	3	-	5	+	8+	+
U. S.	88,478	.6	538	.03	31	.04	39	1.07	964	1.74	1,572

BARLEY

Estimated reduction in yield of barley due to stripe (Helminthosporium gramineum), loose smut (Ustilago nuda), covered smut (Ustilago hordei), and leaf rust (Puccinia simplex), 1919.

State	Production: 1919 Bus. (000 omitted)	Stripe %	Stripe Bus. (000 omitted)	Loose smut %	Loose smut Bus. (000 omitted)	Covered smut %	Covered smut Bus. (000 omitted)	Leaf rust %	Leaf rust Bus. (000 omitted)
Me.	168	-	-	-	-	-	-	-	-
N. H.	25	-	-	-	-	-	-	-	-
Vt.	420	1	4	3	14	2	9	*0	0
Conn.	-	0	0	1	+	1.5	+	-	-
N. Y.	2,486	-	-	1	25	1	25	-	-
Pa.	392	t	+	1	4	1	4	t	+
Md.	198	-	-	-	-	-	-	-	-
Va.	375	t	+	2	8	t	+	*-	-
W. Va.	-	-	-	-	-	-	-	-	-
N. C.	-	-	-	-	-	-	-	-	-
S. C.	-	3	+	2	+	-	-	-	-
Ohio	3,350	2	72	3	108	2	72	*0	0
Ind.	1,430	1	15	1.5	22	.5	7	*0	0
Ill.	5,724	1	58	-	-	-	-	-	-
Mich.	5,320	2	114	-	-	-	-	-	-
Wis.	13,568	1	147	1	147	1	148	*0	0
Minn.	18,200	2	400	1	200	1	200	*0	0
Iowa	8,032	5	464	1	93	.5	46	*0	0
Mo.	330	t	+	1.5	5	1	3	*0	0
N. D.	14,950	1	159	t	+	t	+	*0	0
S. D.	19,250	1	214	1	214	1	214	*0	0
Nebr.	5,577	t	+	1	59	1	59	*-	-
Kans.	16,200	*0	0	2	341	3	512	-	-
Ky.	100	-	-	4	4	1	1	*0	0
Tenn.	176	t	+	5	10	5	10	t	+
Ala.	-	-	-	t	+	1	+	-	-
Texas	875	t	+	3	28	5	48	*0	0
Okla.	1,500	t	+	1	16	3	47	-	-
Ark.	-	-	-	2	+	-	-	-	-
Mont.	540	*0	0	1	5	.5	3	-	-
Wyo.	525	-	-	-	-	-	-	-	-
Colo.	3,900	5	216	1	43	2	87	*0	0
N. Mex	680	2	14	t	+	-	-	*0	0
Ariz.	1,102	-	-	.5	6	1	11	-	-
Utah	720	-	-	-	-	-	-	-	-
Nev.	420	-	-	-	-	1	4	-	-
Ida.	3,360	t	+	.5	17	1	34	*0	0
Wash.	4,140	.5	21	*0	0	.5	21	-	-
Ore.	1,886	*-	-	*0	0	*-	-	*0	0
Calif.	30,000	t	+	t	+	1	303	t	+
U. S.	165,719	1.07	1,898+	.77	1,369+	1.06	1,868+	+	+

BARLEY (Cont.)

Estimated reduction in yield of barley due to stem rust (*Puccinia graminis*, scab (*Fusarium* sp.), and other diseases, 1919.

State	Production: 1919	Estimated reduction yield due to disease							
		Stem rust		Scab		Other diseases		All diseases	
	Bus. (000 omitted)	%	Bus. (000 omitted)	%	Bus. (000 omitted)	%	Bus. (000 omitted)	%	Bus. (000 omitted)
Me.	168	-	-	-	-	t	+	+	+
N. H.	25	-	-	-	-	t	+	+	+
Vt.	420	t	+	-	-	t	+	6. +	27+
Conn.	-	-	-	-	-	t	+	2.5+	+
N. Y.	2,486	t	+	-	-	t	+	2. +	50+
Pa.	392	-	-	t	+	t	+	2. +	8+
Md.	198	-	-	-	-	t	+	+	+
Va.	375	-	-	t	+	t	+	2. +	8+
W. Va.	-	-	-	-	-	t	+	+	+
N. C.	-	-	-	-	-	t	+	+	+
S. C.	-	t	+	-	-	t	+	5. +	+
Ohio	3,350	t	+	t	+	t	+	7. +	252+
Ind.	1,430	t	+	t	+	1	15	4. +	59+
Ill.	5,724	t	+	t	+	-	-	1. +	58+
Mich.	5,320	5	286	-	-	t	+	7. +	400+
Wis.	13,568	5	737	t	+	t	+	8. +	1,179+
Minn.	18,200	5	1,000	t	+	t	+	9. +	1,800+
Iowa	8,032	4	371	3	279	t	+	13.5+	1,253+
Mo.	330	t	+	1	3	t	+	3.5+	11+
N. D.	14,950	5	795	t	+	t	+	6. +	954+
S. D.	19,250	4	855	3	642	t	+	10. +	2,139+
Nebr.	5,577	4	237	-	-	t	+	6. +	355+
Kans.	16,200	t	+	-	-	t	+	5. +	853+
Ky.	100	t	+	1	1	t	+	6. +	6+
Tenn.	176	0	0	1	2	t	+	11. +	22+
Ala.	-	t	+	-	-	t	+	1. +	+
Texas	875	t	+	-	-	t	+	8. +	76+
Okla.	1,500	*0	0	-	-	t	+	4. +	63+
Ark.	-	-	-	-	-	t	+	2. +	+
Mont.	540	0	0	-	-	t	+	1.5+	8+
Wyo.	525	-	-	-	-	t	+	+	+
Colo.	3,900	2	87	-	-	t	+	10. +	433+
N. Mex.	680	t	+	-	-	t	+	2. +	14+
Ariz.	1,102	t	+	-	-	t	+	1.5+	17+
Utah	720	-	-	-	-	t	+	+	+
Nev.	420	-	-	-	-	t	+	1. +	4+
Ida.	3,360	t	+	-	-	t	+	1.5+	51+
Wash.	4,140	t	+	-	-	t	+	1. +	42+
Ore.	1,886	*-	-	-	-	t	+	+	+
Calif.	30,000	t	+	-	-	t	+	1. +	303+
U. S.	165,719	2.47	4,368+	.52	927+	.01	15+	5.9	10,445+

OATS

Estimated reduction in yield of oats due to loose and covered smuts (Ustilago avenae and U. levis stem rust (Puccinia graminis), crown rust (Puccinia coronata), and other diseases, 1919.

State	Production 1919 Bushels 000 omitted	Estimated reduction in yield due to disease.									
		Loose and covered smuts		Stem rust		Crown rust		Other diseases		All diseases	
		%	Bushels 000 omitted	%	Bushels 000 omitted	%	Bushels 000 omitted	%	Bushels 000 omitted	%	Bushels 000 omitted
Me.	5,746	-	-	-	-	-	-	-	-	-	-
N. H.	1,221	-	-	-	-	-	-	-	-	-	-
Vt.	3,960	2.5	109	2	88	5	219	-	-	9.5	416
Mass.	570	1	6	t	+	t	+	t	+	1. +	6+
R. I.	68	-	-	-	-	-	-	-	-	-	-
Conn.	620	2	13	-	-	t	+	t	+	2. +	13+
N. Y.	29,580	2.5	758	t	+	t	+	-	-	2.5+	758+
N. J.	2,460	2	50	-	-	-	-	-	-	2.	50
Pa.	36,059	3	1,164	t	+	1	388	1	388	5. +	1,940+
Del.	115	3	4	-	-	t	+	1	1	4. +	5+
Md.	1,820	4	76	0	0	-	-	-	-	4.	76
Va.	5,280	4	220	*0	0	t	+	-	-	4. +	220+
W. Va.	4,750	5	258	1	52	2	103	-	-	8.	413
N. C.	3,767	5	209	-	-	5	209	-	-	10.	419
S. C.	11,730	7	933	1	133	4	533	-	-	12.	1,599
Ga.	10,800	7	840	1	120	2	240	-	-	10.	1,200
Fla.	1,140	1	12	-	-	-	-	-	-	1.	12
Ohio	51,858	4	2,305	*0	0	1	576	5	2,881	10.	5,762
Ind.	60,225	3	1,892	*0	0	1	631	.5	315	4.5	2,838
Ill.	123,060	5	6,616	0	0	1	1,323	1	1,323	7.	9,263
Mich.	36,875	2	776	-	-	3	1,164	-	-	5.	1,941
Wis.	78,223	1	822	1	822	2	1,645	1	822	5.	4,112
Minn.	90,160	2	1,918	2	1,918	1	959	1	959	6.	5,755
Iowa	196,182	1	2,033	1	2,033	1	2,033	.5	1,016	3.5	7,115
Mo.	38,259	4	1,594	t	+	t	+	t	+	4. +	1,594+

State	Production 1919 Bushels 000 omitted	Estimated reduction in yield due to disease									
		Loose and covered smuts		Stem rust		Crown rust		Other diseases		All diseases	
		%	Bushels 000 omitted	%	Bushels 000 omitted	%	Bushels 000 omitted	%	Bushels 000 omitted	%	Bushels 000 omitted
N. D.	38,400	2	844	5	2,110	t	+	2	844	9. +	3,798+
S. D.	53,650	2	1,179	5	2,948	2	1,179	-	-	9.	5,306
Nebr.	69,962	2	1,489	3	2,233	1	744	-	-	6.	4,466
Kans.	44,229	4	1,843	t	+	t	+	-	-	4. +	1,843+
Ky.	9,900	2	202	*0	0	*0	0	-	-	2.	202
Tenn.	9,200	5	500	0	0	2	200	1	100	8.	800
Ala.	6,696	2.5	172	t	+	t	+	-	-	2.5+	172+
Miss.	5,282	4	224	t	+	2	112	-	-	6. +	337+
La.	1,650	1	17	0	0	2	34	-	-	3.	51
Texas	94,500	6	6,231	1	1,038	2	2,077	-	-	9.	9,346
Okla.	49,500	4	2,129	2	1,065	1	532	t	+	7. +	3,726+
Ark.	9,240	8	850	*0	0	2	208	1	104	11.	1,142
Mont.	6,120	1	62	0	0	*0	0	-	-	1.	62
Wyo.	5,670	-	-	-	-	-	-	-	-	-	-
Colo.	6,524	3	202	t	+	t	+	-	-	3. +	202+
N.Mex.	2,340	1	24	-	-	-	-	-	-	1.	24
Ariz.	533	-	-	-	-	-	-	-	-	-	-
Utah	2,448	-	-	-	-	-	-	-	-	-	-
Nev.	384	2	8	*0	0	-	-	-	-	2.	8
Ida.	7,700	3	243	t	+	*0	0	2	162	5. +	405+
Wash.	12,800	2	261	t	+	*0	0	t	+	2. +	261+
Ore.	11,104	1	112	*0	0	t	+	t	+	1. +	112+
Calif.	5,250	1	58	8	467	1	58	-	-	10.	583
U. S.	1,248,310	2.95	39,238	1.13	15,027	1.14	15,167	.67	8,915	5.9	78,353

CORN

Estimated reduction in yield of corn due to smut (Ustilago zeae), leaf rust (Puccinia sorghi), Physoderma (Physoderma zeae-maydis), root and ear rots (Fusarium sp.), and other diseases, 1919

State	Production: 1919 Bushels (000 omitted)	Estimated reduction in yield due to disease. Smut %	Smut Bushels (000 omitted)	Leaf rust %	Leaf rust Bushels (000 omitted)	Physoderma %	Physoderma Bushels (000 omitted)	Root and Ear rots %	Root and Ear rots Bushels (000 omitted)	Other diseases %	Other diseases Bushels (000 omitted)	All diseases %	All diseases Bushels (000 omitted)
Me.	1,100	-	-	0	0	0	0	-	-	-	-	-	-
N. H.	1,050	*-	-	0	0	0	0	-	-	-	-	-	-
Vt.	2,120	.5	11	0	0	0	0	-	-	-	-	.5	11
Mass.	2,640	.5	13	t	+	0	0	t	+	t	+	.5+	13+
R. I.	495	.5	2	-	-	0	0	-	-	-	-	.5	2
Conn.	3,300	.5	16	t	+	0	0	.5	17	-	-	1. +	33+
N. Y.	35,260	.5	178	-	-	0	0	.5	178	-	-	1.	356
N. J.	10,800	1.	111	-	-	0	0	2.	223	-	-	3.	334
Pa.	42,192	2.	940	t	+	0	0	8.	3,759	-	-	10. +	4,699+
Dela.	6,900	1.	70	-	-	0	0	.5	35	-	-	1.5	105
Md.	28,413	1.5	446	-	-	0	0	3.	893	-	-	4.5	1,339
Va.	44,800	1.	477	t+	+	t	+	5.	2,383	t	+	6. +	2,860+
W. Va.	24,990	2.	532	t	+	0	0	4.	1,063	-	-	6. +	1,595+
N. C.	55,100	2.	1,191	-	-	.5	298	5.	2,978	-	-	7.5	4,467
S. C.	37,440	3.	1,195	-	-	1.	398	2.	797	-	-	6.	2,390
Ga.	69,890	3.	2,304	-	-	1.	768	5.	3,840	-	-	9.	6,912
Fla.	12,600	-	-	-	-	.5	63	*-	-	-	-	.5	63
Ohio	162,800	2.	3,618	-	-	0	0	8.	14,471	-	-	10.	18,089
Ind.	175,750	3.	5,731	*0	0	0	0	5.	9,552	-	-	8.	15,283
Ill.	301,000	2.	6,473	t	+	*0	0	5.	16,183	-	-	7. +	22,656+
Mich.	64,350	2.	1,313	-	-	0	0	t	+	-	-	2. +	1,313+
Wis.	85,540	1.	864	t	+	0	0	t	+	t	+	1. +	864+
Minn.	118,000	1.	1,192	t	+	0	0	t	+	-	-	1. +	1,192+
Iowa	416,000	3.	13,419	t	+	0	0	4.	17,892	-	-	7. +	31,311+
Mo.	155,412	2.	3,272	t	+	t	+	3.	4,908	-	-	5. +	8,180+

Corn -2

State	Production: 1919 Bushels (000 omitted)	Estimated reduction in yield due to disease. Smut %	Smut Bushels (000 omitted)	Leaf rust %	Leaf rust Bushels (000 omitted)	Physoderma %	Physoderma Bushels (000 omitted)	Root and ear rots %	Root and ear rots Bushels (000 omitted)	Other diseases %	Other diseases Bushels (000 omitted)	All diseases %	All diseases Bushels (000 omitted)
N. D.	16,764	1.	171	-	-	-	-	1.	171	-	-	2.	342
S. D.	91,200	2.	1,900	0	0	-	-	2.	1,900	-	-	4.	3,800
Nebr.	184,186	3.	5,816	t	+	-	-	2.	3,878	-	-	5. +	9,694+
Kans.	69,362	5.	3,729	t	+	t	+	2.	1,492	-	-	7. +	5,221+
Ky.	82,500	2.	1,875	0	0	t	+	10.	9,375	-	-	12. +	11,250+
Tenn.	74,750	2.	1,709	t	+	.5	427	10.	8,543	t	+	12.5+	10,679+
Ala.	62,843	1.	676	t	+	1.	676	5.	3,378	-	-	7. +	4,730+
Miss.	59,700	1.	642	t	+	1.	642	5.	3,210	-	-	7. +	4,494
La.	32,375	.5	182	5.	1,819	.5	181	5.	1,819	-	-	11	4,001
Texas	202,800	3.	6,472	-	-	-	-	3.	6,472	-	-	6.	12,944
Okla.	74,400	3.	2,400	t	+	t	+	4.	3,200	-	-	7. +	5,600+
Ark.	48,726	t	+	t	+	t	+	5.	2,565	t	+	5. +	2,565+
Mont.	1,728	-	-	-	-	-	-	-	-	-	-	-	-
Wyo.	768	-	-	-	-	-	-	-	-	-	-	-	-
Colo.	11,206	5.	590	t	+	-	-	0	0	-	-	5. +	590+
N. Mex.	7,200	1.	73	t	+	-	-	-	-	-	-	1. +	73+
Ariz.	1,287	-	-	-	-	-	-	-	-	-	-	-	-
Utah.	432	-	-	-	-	-	-	-	-	-	-	-	-
Nev.	90	t	+	-	-	-	-	-	-	-	-	+	+
Ida.	840	-	-	-	-	-	-	-	-	-	-	-	-
Wash.	1,620	t	+	0	0	-	-	0	0	-	-	+	+
Ore.	1,860	t	+	0 -	0	0	0	t	+	-	-	+	+
Calif.	2,871	-	-	-	-	-	-	-	-	-	-	-	-
U. S.	2,917,450	2.23	69,603	.05	1,819+	.11	3,453+	4.02	125,175+		+	6.41	200,050+

POTATO

Estimated reduction in yield of potatoes due to late blight (Phytophthora infestans), Rhizoctonia (Rhizoctonia solani), black leg (Bacillus atrosepticus), Fusarium wilt (Fusarium oxysporum), and early blight (Macrosporium solani), 1919.

State	Production 1919 Bushels 000 omitted	Estimated reduction in yield due to disease									
		Late blight		Rhizoctonia		Black leg		Fusarium wilt		Early blight	
		%	Bushels 000 omitted	%	Bushels 000 omitted	%	Bushels 000 omitted	%	Bushels 000 omitted	%	Bushels 000 omitted
Maine	24,480	10.	3,060	-	-	t	+	0	0	0	0
New Hampshire	2,400	20.	706	t	+	t	+	0	0	t	+
Vermont	3,125	15.	808	-	-	t	+	0	0	t	+
Massachusetts	2,970	20.	784	.2	8	t	+	t	+	t	+
Rhode Island	425	25.	143	-	-	-	-	0	0	t	+
Connecticut	1,680	30.	782	t	+	t	+	0	0	t	+
New York	39,567	8.	3,746	1.	468	t	+	.5	234	-	-
New Jersey	10,560	5.	695	2.	277	-	-	-	-	6.	834
Pennsylvania	25,400	15.	6,804	3.	1,361	t	+	2.	907	5.	2,268
Delaware	913	5.	61	.5	6	1.	12	1.	12	15.	181
Maryland	5,170	10.	680	2.	136	1.	68	t	+	3.	204
Virginia	11,495	2.	239	1.	120	1.	120	t	+	-	-
West Virginia	5,130	15.	1,026	-	-	-	-	3.	205	2.	137
North Carolina	4,930	1.	53	1.	53	1.	53	1.	53	1.	53
South Carolina	2,295	t	+	2.	48	-	-	-	-	1.	24
Georgia	1,610	2.	34	.2	3	.1	2	0	0	1.	17
Florida	1,824	15.	360	-	-	-	-	0	0	5.	120
Ohio	9,300	t	+	t	+	t	+	6	653	8.	870
Indiana	4,400	-	-	1.	49	0	0	4.	196	t	+
Illinois	8,060	0	0	*-	-	-	-	-	-	3.	271
Michigan	28,688	t	+	5.	2,049	t	+	-	-	t	+
Wisconsin	28,200	3.	929	2.	620	t	+	t	+	1.	310
Minnesota	26,100	0	0	1.5	458	1.	305	3.	916	t	+
Iowa	4,945	t	+	-	-	-	-	-	-	t	+
Missouri	8,250	t	+	t	+	-	-	2.	168	t	+

State	Production 1919 Bushels (00 omitted	Estimated reduction in yield due to disease									
		Late blight		Rhizoctonia		Black leg		Fusarium wilt		Early blight	
		%	Bushels 000 omitted	%	Bushels 000 omitted	%	Bushels 000 omitted	%	Bushels 000 omitted	%	Bushels 000 omitted
North Dakota	5,670	0	0	1.5	90	t	+	1.5	90	t	+
South Dakota	4,500	.5	27	2.	107	.5	27	2.	107	5.	268
Nebraska	6,325	0	0	3.	228	4.	305	10.	762	t	+
Kansas	5,168	0	0	4.	295	10.	738	5.	369	10.	738
Kentucky	5,040	t	+	-	-	-	-	5.	371	15.	1,112
Tennessee	3,120	0	0	0	0	-	-	1.	38	15.	578
Alabama	3,520	0	0	t	+	0	0	t	+	-	-
Mississippi	1,530	0	0	-	-	0	0	t	+	5.	90
Louisiana	1,600	0	0	0	0	0	0	t	+	t	+
Texas	3,796	0	0	2.	83	0	0	1.	42	1.	42
Oklahoma	3,520	0	0	0	0	0	0	-	-	t	+
Arkansas	3,321	0	0	t	+	2.	90	3.	135	1.	45
Montana	2,820	0	0	-	-	2.	58	-	-	0	0
Wyoming	2,640	0	0	-	-	-	-	-	-	-	-
Colorado	11,040	0	0	1.	118	1.	118	2.	236	.5	59
New Mexico	495	0	0	-	-	-	-	-	-	t	+
Arizona	350	0	0	-	-	-	-	-	-	.25	1
Utah	2,397	0	0	-	-	-	-	-	-	-	-
Nevada	900	0	0	t	+	*-	-	15.	130	-	-
Idaho	5,400	0	0	5.	351	3.	210	5.	351	t	+
Washington	7,250	.5	41	10.	319	t	+	t	+	0	0
Oregon	4,230	t	+	10.	498	2.	99	t	+	*-	-
California	11,352	t	+	5.	668	-	-	8.	1,068	2.	257
United States	357,901	4.7	20,978	2.	8,913	.5	2,205	1.6	7,093	1.9	8,489

POTATO (Continued)

Estimated reduction in yield or potatoes due to mosaic, leaf roll, tip burn, and other diseases, 1919.

State	Production 1919 Bushels 000 omitted	Estimated reduction in yield due to disease.									
		Mosaic		Leaf roll		Tip burn		Other diseases		All diseases	
		%	Bushels 000 omitted	%	Bushels 000 omitted	%	Bushels 000 omitted	%	Bushels 000 omitted	%	Bushels 000 omitted
Maine	24,480	8.	2,448	2.	612	-	-	-	-	20. +	6,120+
New Hampshire	2,400	12.	423	-	-	-	-	-	-	32. +	1,129+
Vermont	3,125	12.	647	5.	269	10.	539	-	-	42. +	2,263+
Massachusetts	2,970	3.	117	1.	39	t	+	-	-	24.2+	948+
Rhode Island	425	1.	6	t	+	-	-	-	-	26. +	149+
Connecticut	1,680	t	+	t	+	.5	13	5.	130	35.5+	925+
New York	39,567	4.	1,873	2.	937	-	-	-	-	15.5+	7,258+
New Jersey	10,560	8.	1,112	3.	417	-	-	-	-	24.	3,335
Pennsylvania	25,400	2.	907	10.	4,535	5.	2,268	2.	907	44. +	19,957+
Delaware	913	-	-	-	-	2.	24	-	-	24.5+	296+
Maryland	5,170	4.	272	2.	136	2.	136	-	-	24. +	1,632+
Virginia	11,495	t	+	-	-	-	-	-	-	4. +	479+
West Virginia	5,130	t	+	-	-	5.	342	-	-	25. +	1,710+
North Carolina	4,930	t	+	-	-	-	-	2.	106	7. +	371+
South Carolina	2,295	1.	24	-	-	1.	24	-	-	5. +	120+
Georgia	1,610	3.	52	-	-	.1	2	.1	2	6.5	112
Florida	1,824	4.	96	-	-	-	-	-	-	24.	576
Ohio	9,300	-	-	-	-	.5	54	-	-	14.5+	1,577+
Indiana	4,400	-	-	-	-	5.	244	-	-	10. +	489+
Illinois	8,060	2.	181	3.	272	3.	272	-	-	11. +	996+
Michigan	28,688	t	+	-	-	25.	10,246	-	-	30. +	12,295+
Wisconsin	28,200	1.	310	t	+	2.	620	-	-	9. +	2,789+
Minnesota	26,100	3.	916	t	+	2.	610	4.	1,221	14.5+	4,426+
Iowa	4,945	t	+	-	-	*-	-	-	-	+	+
Missouri	8,250	-	-	-	-	-	-	-	-	2. +	168+

Potato (Continued)-2

State	Production	Estimated reduction in yield due to disease									
	Bushels :000 omitted	Mosaic		Leaf roll		Tip burn		Other diseases		All diseases	
		%	Bushels :000 omitted	%	Bushels :000 omitted	%	Bushels :000 omitted	%	Bushels :000 omitted	%	Bushels :000 omitted
North Dakota	5,670	t	+	t	+	1.	60	2.	121	6. +	361+
South Dakota	4,500	t	+	t	+	1.	53	5.	268	16. +	857+
Nebraska	6,325	t	+	t	+	-	-	-	-	17. +	1,295+
Kansas	5,168	t	+	0	0	1.	74	-	-	30. +	2,214+
Kentucky	5,040	8.	593	2	148	2.	148	-	-	32.	2,372
Tennessee	3,120	1.	33	t	+	2.	77	-	-	19. +	731+
Alabama	3,520	12.	494	-	-	1.	41	1.5	62	14.5+	597+
Mississippi	1,530	10.	180	-	-	-	-	-	-	15. +	270+
Louisiana	1,600	10.	181	t	+	t	+	1.5	27	11.5+	208+
Texas	3,796	.5	21	.5	21	1.	41	3.	125	9. +	375+
Oklahoma	3,520	t	+	t	+	-	-	-	-	+	+
Arkansas	3,321	10.	449	t	+	5.	224	5.	224	26. +	1,167+
Montana	2,320	t	+	-	-	-	-	-	-	2. +	58+
Wyoming	2,640	-	-	-	-	-	-	-	-	-	-
Colorado	11,040	t	+	-	-	2.	236	-	-	6.5+	767+
New Mexico	495	-	-	-	-	-	-	-	-	+	+
Arizona	350	-	-	t	+	-	-	-	-	.25+	1+
Utah	2,397	-	-	-	-	-	-	-	-	-	-
Nevada	900	-	-	-	-	-	-	10.	120	25. +	300+
Idaho	5,400	t	+	t	+	t	+	10.	701	23. +	1,613+
Washington	7,250	t	+	t	+	0	0	1.	82	11.5+	942+
Oregon	4,230	-	-	-	-	-	-	3.	149	15. +	746+
California	11,352	-	-	-	-	-	-	-	-	15. +	2,003+
United States	357,901	2.5	11,340	1.7	7,386	3.7	16,348	.9	4,245	19.5	86,997

TOMATO

Estimated reduction in yield of tomatoes due to leaf spot (Septoria lycopersici), Fusarium wilt (Fusarium lycopersici), bacterial wilt (Bacillus solanacearum), early blight (Macrosporium solani), yellow blight (Fusarium spp.), and other diseases, 1919.

State	Production: 1919 Tons	Estimated reduction in yield due to disease											
		Leaf spot		Fusarium wilt		Bacterial wilt		Early blight		Yellow blight		Other diseases		All diseases	
		%	Tons	%	Tons	%	Tons	%	Tons	%	Tons	%	Tons	%	Tons
Me.	-	-	-	0	0	0	0	-	-	-	-	-	-	-	-
N. H.	-	-	-	0	0	0	0	-	-	-	-	-	-	-	-
Vt.	-	-	-	0	0	0	0	-	-	0	0	3.	+	3.	+
Mass.	-	t	+	t	+	t	+	5.	+	0	0	t	+	5. +	+
R. I.	-	1.	+	t	+	0	0	-	-	0	0	-	-	1. +	+
Conn.	-	1.	+	0	0	0	0	t	+	0	0	2.	+	3. +	+
N. Y.	58,552	1.	623	t	+	0	0	t	+	0	0	5.	3,114	6. +	3,737+
N. J.	35,944	10.	5,991	t	+	0	0	3.	1,797	0	0	27.	16,174	40. +	23,962+
Pa.	8,201	3.	296	1.	99	t	+	3.	296	0	0	10.	988	17. +	1,679+
Del.	11,607	10.	2,232	5.	1,116	t	+	1.	223	0	0	32.	7,143	48. +	10,714+
Md.	80,399	45.	87,722	7.	13,645	t	+	.5	975	0	0	6.	11,696	58.5+	114,038+
Va.	45,073	25.	16,097	1.	644	t	+	1.	644	0	0	3.	1,932	30. +	19,317+
W. Va.	3,597	10.	536	3.	161	t	+	10.	536	0	0	8.	428	31. +	1,661+
N. C.	-	10.	+	5.	+	5.	+	1.	+	0	0	2.	+	23.	+
S. C.	-	10.	+	3.	+	5.	+	1.	+	0	0	-	+	19.	+
Ga.	-	5.	+	40.	+	5.	+	2.	+	0	0	15.	+	67.	+
Fla.	56,792	t	+	5.	4,369	5.	4,368	25.	21,843	0	0	-	-	35. +	30,580+
Ohio	37,988	10.	4,870	10.	4,870	t	+	2.	974	0	0	-	-	22.	10,714
Ind.	162,460	4.	7,469	3.	5,602	0	0	-	-	0	0	6.	11,204	13.	24,275
Ill.	14,329	4.	623	4.	623	0	0	-	-	0	0	-	-	8.	1,246
Mich.	8,642	t	+	0	0	0	0	0	0	0	0	-	-	+	+
Wis.	-	t	+	t	+	0	0	t	+	0	0	t	+	+	+
Minn.	-	t	+	t	+	0	0	0	0	0	0	2.	+	2. +	+
Iowa	11,771	t	+	-	-	0	0	0	0	0	0	-	-	+	+
Mo.	22,139	2	487	5.	1,216	2.	487	t	+	0	0	-	-	9. +	2,190+

	Production: 1919 Tons	Estimated reduction in yield due to disease: Leaf spot %	Leaf spot Tons	Fusarium wilt %	Fusarium wilt Tons	Bacterial wilt %	Bacterial wilt Tons	Early blight %	Early blight Tons	Yellow blight %	Yellow blight Tons	Other diseases %	Other diseases Tons	All diseases %	All diseases Tons
N. D.	-	t	+	0	0	0	0	0	0	0	0	-	-	+	+
S. D.	-	t	+	0	0	0	0	0	0	0	0	-	-	+	+
Nebr.	-	1.	+	-	-	t	+	0	0	0	0	-	-	1. +	+
Kans.	-	5.	+	8.	+	0	0	0	0	0	0	-	-	13.	+
Ky.	9,744	15.	1,850	6.	740	t	+	-	-	0	0	-	-	21. +	2,590+
Tenn.	22.952	15.	4,918	10.	3,279	1.	328	2.	656	0	0	2.	656	30.	9,837
Ala.	45	5.	4	25.	19	5.	4	5.	3	0	0	-	-	40.	30
Miss.	18,400	4.	1,443	15.	5,412	5.	1,804	5.	1,804	0	0	20.	7,215	40.	17,678
La.	-	t	+	25.	+	10.	+	12.	+	0	0	15.	+	62. +	+
Texas	17,700	5.	983	1.	197	1.	197	1.	197	0	0	2.	393	10.	1,967
Okla.	-	2.	+	3.	+	-	-	-	-	0	0	-	-	5.	+
Ark.	10,040	t	+	2.	224	1.5	168	2.	224	0	0	5.	561	10.5+	1,177+
Mont.	-	-	-	0	0	0	0	0	0	0	0	-	-	-	-
Wyo.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Colo.	9,114	.5	46	-	-	-	-	t	+	-	-	-	-	.5+	46+
N.Mex.	-	0	0	-	-	-	-	-	-	-	-	-	-	-	-
Ariz.	-	0	0	-	-	-	-	-	-	30.	+	-	-	30.	+
Utah	35,916	0	0	-	-	-	-	-	-	-	-	-	-	-	-
Nev.	-	0	0	-	-	0	0	-	-	10.	+	-	-	10.	+
Ida.	-	0	0	-	-	0	0	-	-	50.	+	-	-	50.	+
Wash.	-	0	0	-	-	0	0	0	0	10.	+	2.	+	12. +	+
Ore.	-	0	0	0	0	0	0	0	0	15.	+	*-	-	15.	+
Calif.	199,052	-	-	3.	6,861	-	-	-	-	-	-	10.	22,869	13.	29,730
All other	6,785	-	-	-	-	-	-	-	-	-	-	-	-	-	
U. S.	837,842	11.4	136,190	4.1	49,077	.6	7,356	2.5	30,172	+	+	7.1	84,373	25.7	307,168

SWEET POTATO

Estimated reduction in yield of sweet potatoes due to stem rot (Fusarium hyperoxysporum and F. batatis), foot rot (Plenodomus destruens), black rot (Sphaeronema fimbriatum), storage rots, pox (Cystospora batata), and other diseases, 1919.

State	Production 1919 Bus. (000 omitted)	Stem rot %	Stem rot Bus. (000 omitted)	Foot rot %	Foot rot Bus. (000 omitted)	Black rot %	Black rot Bus. (000 omitted)	Storage rots %	Storage rots Bus. (000 omitted)	Pox %	Pox Bus. (000 omitted)	Other diseases %	Other diseases Bus. (000 omitted)	All diseases %	All diseases Bus. (000 omitted)
N. J.	1,750	10.	263	-	-	15.	395	10.	264	1.	26	-	-	36.	948
Pa.	138	-	-	-	-	-	-	-	-	0	0	-	-	-	-
Del.	966	15.	216	-	-	6.	87	10.	144	2.	29	-	-	33.	476
Md.	1,600	10.	224	3.	67	5.	112	5.	112	2.	45	-	-	25.	560
Va.	4,750	10.	688	5.	344	5.	344	10.	689	1.	69	-	-	31.	2,134
W. Va	230	-	-	-	-	-	-		-	0	0	-	-	-	-
N. C.	9,858	1.	143	-	-	10.	1,429	20.	2,857	0	0	-	-	31.	4,429
S. C.	7,560	t	+	-	-	7.	1,103	40.	6,300	0	0	5.	787	52. +	8,190+
Ga.	13,064	t	+	0	0	12	3,199	35.	9,332	0	0	4.	1,066	51.	13,597+
Fla.	4,100	1.	45	-	-	2.	89	-	-	0	0	5.	223	8.	357
Ohio	115	2.	2	2.	2	2.	3	-	-	0	0	-	-	6.	7
Ind.	315	-	-	-	-	t	+	-	-	0	0	-	-	+	+
Ill.	855	2.	18	-	-	2.	18	-	-	-	-	-	-	4.	36
Iowa	320	3.	10	3.	10	2.	7	-	-	0	0	-	-	8.	27
Mo.	832	+	+	t	+	1.	8	-	-	-	-	-	-	1. +	8+
Kans.	436	10.	70	t	+	8.	56	20.	141	t	+	-	-	38. +	267+
Ky.	1,680	-	-	-	-	-	-	15.	296	0	0	-	-	15.	296
Tenn.	4,400	.5	31	0	0	10.	607	15.	910	0	0	2.	121	27.5	1,669
Ala.	14,194	1.	237	t	+	1.	237	35.	8,280	0	0	3.	709	40. +	9,463+
Miss.	10,290	*-	-	-	-	5.	903	35.	6,318	0	0	3.	542	43.	7,763
La.	6,300	t	+	0	0	1.	89	25.	2,218	0	0	3.	266	29. +	2,573+
Texas	10,450	t	+	0	0	2.	286	20.	2,863	1.	143	4.	573	27. +	3,865+
Okla.	3,000	1.	37	*-	-	2.	73	15.	549	-	-	-	-	18.	659
Ark.	4,600	3.	177	-	-	1.	59	15.	884	t	+	3.	177	22.	1,297
N.Mex.	450	-	-	-	-	5.	28	15.	84	0	0	-	-	20.	112
Ariz.	150	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Calif.	1,096	5.	60	2.	24	2.	24	-	-	-	-	-	-	9.	108
U. S.	103,579	1.37+	2,221+	.28+	447+	5.64+	9,156+	26.	42,241	.19	312+	2.75	4,464	36.25+	58,841+

DRY BEANS

Estimated reduction in yield of dry beans due to anthracnose (Colletotrichum lindemuthianum), blight, mosaic, root rots, and other diseases. 1919.

State	Production: 1919 Bushels (000 omitted)	Estimated reduction in yield due to disease											
		Anthracnose		Blight		Mosaic		Root rots		Other diseases		All diseases	
		%	Bushels (000 omitted)	%	Bushels (000 omitted)	%	Bushels (000 omitted)	%	Bushels (000 omitted)	%	Bushels (000 omitted)	%	Bushels (000 omitted)
N. Y.	1,450	2.	35	5.	87	5.	87	5.	87	-	-	17.	296
Mich.	4,030	t	+	3.	125	-	-	-	-	-	-	3.+	125+
Colo.	448	0	0	t	+	1.	5	2.	9	-	-	3.+	14+
N. Mex.	960	0	0	-	-	-	-	t	+	-	-	+	+
Ariz.	136	t	+	-	-	0	0	-	-	-	-	+	+
Calif.	4,464	-	-	-	-	-	-	-	-	-	-	-	-
U. S.	11,488	.3	35	1.8	212	.8	92	.8	96	-	-	3.7	435

SNAP BEAN

Estimated reduction in yield of snap beans due to anthracnose (Colletotrichum lindemuthianum), blight (Bacterium phaseoli), mosaic, root rots, and other diseases, 1919.

State	Production: 1919 Tons	Estimated reduction in yield due to disease.											
		Anthracnose		Blight		Mosaic		Root rots		Other diseases		All diseases	
		%	Tons	%	Tons	%	Tons	%	Tons	%	Tons	%	Tons
Me.	378	8.	33	0	0	-	-	-	-	-	-	8	33
N. H.	-	3.	+	t	+	-	-	-	-	-	-	3. +	.+
Vt.	-	4.	+	-	-	t	+	-	-	-	-	4 +	+
Mass.	-	.5	+	t	+	t	+	5.	+	t	+	5.5+	+
Conn.	-	.4	+	.3	+	t	+	-	-	-	-	.7+	.+
N. Y.	7,038	2.	170	5.	424	5.	424	5.	424	-	-	17.	1,442
N. J.	-	-	-	1.	+	+	+	-	-	-	-	1. +	+
Pa.	798	5.	48	5.	48	2.	19	4.	38	1.	10	17.	163
Md.	3,160	-	-	-	-	-	-	-	-	-	-	-	-
Va.	265	3.	8	t	+	t	+	t	+	-	-	3. +	8+
W. Va.	-	5.	+	t	+	-	-	-	-	-	-	5. +	+
N. C.	-	2.	+	2.	+	-	-	-	-	-	-	4.	+
S. C.	-	1.	+	3.	+	t	+	-	-	-	-	4. +	+
Ga.	-	-	-	+	+	1.	+	2.	+	-	-	3. +	+
Fla.	-	1.	+	+	+	-	-	-	-	-	-	1. +	+
Ohio	412	7.	31	-	-	-	-	-	-	-	-	7.	31
Ind.	442	t	+	t	+	6.	28	-	-	-	-	6. +	28+
Mich.	904	t	+	3.	28	4.	-	-	-	-	-	3. +	28+
Wis.	1,692	t	+	4.	71	t	+	t	+	t	+	4. +	71+
Minn.	510	2.	11	2.	10	t	+	t	+	t	+	4. +	21+
Mo.	-	t	+	-	-	-	-	-	-	-	-	+	+
S. D.	-	5.	+	1.	+	0	0	1.	+	1.	+	8.	+
Nebr.	-	t	+	-	-	-	-	t	+	-	-	+	+
Kans.	-	t	+	0	0	2.	+	1.	+	-	-	3. +	+
Ky.	-	2.	+	-	-	-	-	-	-	-	-	2.	+
Tenn.	206	5.	12	5.	12	5.	12	0	0	t	+	15. +	36+

State	Production: 1919 Tons	Estimated reduction in yield due to diseaso.											
		Anthracnose		Blight		Mosaic		Root rots		Other diseases		All diseases	
		%	Tons	%	Tons	%	Tons	%	Tons	%	Tons	%	Tons
Ala.	-	-	-	-	-	t	+	+	+	-	-	+	+
Miss.	-	7.	+	5.	+	+	+	-	-	-	-	12. +	+
La.	-	2.	+	8.	+	2.	+	3.	+	-	-	15.	+
Texas	-	5.	+	3.	+	+	+	3.	+	-	-	11. +	+
Okla	-	0	0	1.	+	+	+	-	-	-	-	1. +	+
Ark.	282	2.	6	1.	3	t	+	t	+	-	-	3. +	9+
Colo.	2,083	0	0	t	+	1	21	2.	43	-	-	3. +	64+
N. Mex.	-	0	0	-	-	-	-	t	+	-	-	+	+
Ariz.	-	.1	+	-	-	0	0	-	-	-	-	.1	+
Utah	558	-	-	-	-	-	-	-	-	-	-	-	-
Nev.	-	0	0	-	-	-	-	-	-	1.	+	1.	+
Ida.	-	0	0	-	-	10.	+	t	+	1.	+	11. +	+
Wash.	312	0	0	0	0	0	0	1.	32	-	-	1.	32
Ore.	1,874	*0	0	*-	-	15. +	331+	-	-	-	-	15. +	331+
Calif.	3,020	-	-	-	-	-	-	-	-	-	-	-	-
All-others	1,124												
U. S.	25,058	1.17	319	2.18	596	3.05	835	1.96	537	.04	10	8.4	2,297

COTTON

Estimated reduction in yield of cotton due to anthracnose (Colletotrichum gossypsii), angular leaf spot (Bacterium malvacearum), wilt (Fusarium vasinfectum), root knot (Heterodera radicicola), and other diseases, 1919.

State	Production: 1919 Bales	Estimated reduction in yield due to disease. Anthracnose %	Anthracnose Bales	Angular leaf spot %	Angular leaf spot Bales	Wilt %	Wilt Bales	Root knot %	Root knot Bales	Other diseases %	Other diseases Bales	All diseases %	All diseases Bales
Va.	22,000	2.	500	t		*-	-	t	+	10.	2,500	12. +	3,000+
N. C.	875,000	5.	51,450	1.	10,290	5.	51,450	1.	10,290	3.	31,870	15.	154,350
S. C.	1,475,000	3.	49,980	2.	33,320	2.	33,320	1.5	24,990	3.	49,980	11.5	191,590
Ga.	1,730,000	8.	175,120	2.	43,780	4.	87,560	4.	87,560	3.	65,670	21.	459,690
Fla.	17,000	*-	-	*-	-	*-	-	*-	-	-	-	-	-
Mo.	60,000	-	-	-	-	*-	-	-	-	-	-	-	-
Tenn.	298,000	8.	26,488	2.	6,622	t	+	0	0	t	+	10. +	33,110+
Ala.	715,000	4.	32,480	t	+	5.	40,600	2.	16,240	1.	8,120	12. +	97,440+
Miss.	946,000	5.	54,350	1.	10,870	4.	43,480	2.	21,740	1.	10,870	13.	141,310
La.	300,000	2.	6,660	1.	3,330	5.	16,650	1.	3,330	1.	3,330	10.	33,300
Texas	2,700,000	1.5	47,085	1.	31,390	1.	31,390	.5	15,695	10.	313,900	14.	439,460
Okla.	930,000	1.	10,210	1.5	15,315	1.	10,210	.5	5,105	5.	51,050	9.	91,890
Ark.	830,000	1.5	13,530	1.5	13,530	2.	18,040	t	+	3.	27,060	8. +	72,160+
Ariz.	75,000	-	-	10.	10,000	-	-	-	-	15.	15,000	25.	25,000
Calif.	102,000	-	-	-	-	-	-	-	-	-	-	-	-
Other States	7,000	-	-	-	-	-	-	-	-	-	-	-	-
U. S.	11,082,000	3.65	468,853	1.39	178,447	2.59	332,700	1.44	184,950	4.52	579,350	13.59	1,742,300

PEACH

Estimated reduction in yield of peaches due to leaf curl (Exoascus deformans), brown rot (Sclerotinia cinerea), blossom blight, and other diseases, 1919.

State	Production Bushels 000 omitted	Estimated reduction in yield due to diseases: Leaf curl %	Leaf curl Bus. (000 omitted)	Brown rot & blossom blight %	Brown rot & blossom blight Bus. (000 omitted)	Other diseases %	Other diseases Bus. (000 omitted)	All diseases %	All diseases Bus. (000 omitted)
N. H.	43	-	-	-	-	-	-	-	-
Mass.	160	1.	2	15.	28	t	+	16.+	30+
R. I.	-	1.	+	10.	+	1.	+	12.	+
Conn.	200	1.	3	20.	51	1.	2	22.	56
N. Y.	1,648	5.	111	20.	445	1.	22	26.	578
N. J.	1,018	6.	102	30.	509	4.	68	40.	679
Pa.	1,200	5.	86	20.	342	5.	86	30.	514
Del.	277	8.	69	50.	433	10.	87	68.	589
Md.	731	10.	105	18.	191	3.	32	31.	328
Va.	928	3.	33	10.	109	2.	22	15.	164
W. Va.	760	5.	44	5.	44	3.	26	13.	114
N. C.	713	3.	25	10.	85	3.	25	16.	135
S. C.	466	2.	12	20.	124	3.	19	25.	155
Ga.	5,895	7.	589	20.	1,684	3.	253	30.	2,526
Ohio	428	3.	15	8.	40	3.	15	14.	70
Ind.	150	2.	2	t	+	2.	2	4.+	4+
Ill.	790	t	+	1.	8	2.	16	3.+	24+
Mich.	480	2.	10	t	+	-	-	2.+	10+
Iowa	3	t	+	-	-	-	-	+	+
Mo.	828	t	+	3.	26	t	+	3.+	26+
Nebr.	-	t	+	t	+	-	-	+	+
Kans.	80	t	+	1.	1	2.	2	3.+	3+
Ky.	726	1.	8	4.	30	1.	8	6.	46
Tenn.	978	1.	11	10.	112	2.	23	13.	146
Ala.	1,678	t	+	8.	94	3.	36	11.+	130+
Miss.	-	t	+	15.	+	3.	+	18.+	+
La.	-	0	0	25.	+	-	-	25.	+
Texas	2,760	t	+	t	+	6.	176	6.+	176+
Okla.	1,007	t	+	1.	11	3.	31	4.+	42+
Ark.	3,639	t	+	3.	119	5.	197	8.+	316+
Colo.	840	*0	0	0	0	1.	8+	1.+	8+
N. Mex.	145	-	-	-	-	-	-	-	-
Utah	1,500	-	-	-	-	-	-	-	-
Ida.	350	1.	4	-	-	8.	31	9.	35
Wash.	1,899	1.	19	t	+	1.	19	2.+	38+
Ore.	513	5.	30	4.	24	5.+	30	14.+	84+
Calif.	18,506	*-	-	-	-	-	-	+	+
U. S.	51,340	2.21	1,288	7.71	4,502	2.12	1,236	12.04	7,026

Estimated reduction in yield of apples due to bitter rot (*Glomerella cingulata*), black rot (*Physalospora cydoniae*), blotch (*Phyllosticta solitaria*), and cedar rust (*Gymnosporangium juniperi-virginianae*), 1919.

State	Production	Estimated reduction in yield due to disease.							
		Bitter rot		Black rot		Blotch		Cedar rust	
	Bushels 000 omitted	%	Bus. (000 omitted)	%	Bus. (000 omitted)	%	Bus. (000 omitted)	%	Bus. (000 omitted)
Me.	4,630	0	0	t	+	0	0	-	-
N. H.	1,510	0	0	t	+	0	0	-	-
Vt.	1,500	0	0	1.	16	0	0	-	-
Mass.	3,240	t	+	1.	33	0	0	t	+
R. I.	294	t	+	1.	3	0	0	t	+
Conn.	1,572	t	+	2.	33	0	0	t	+
N. Y.	16,800	t	+	1.	193	0	0	t	+
N. J.	2,313	1.5	37	3.	73	t	+	t	+
Pa.	7,972	1.	101	3.	302	1.	101	1.	101
Del.	750	-	-	3.	24	t	+	t	+
Md.	1,944	1.	21	3.	64	t	+	.5	11
Va.	9,950	5.	726	3.	436	1.	145	15.	2,179
W. Va.	3,478	1.	40	5.	200	t	+	3.	120
N. C.	1,108	5.	92	8.	148	5.	92	8.	148
S. C.	700	25.	336	8.	108	2.	27	2.	27
Ga.	636	10.	107	10.	107	3.	32	t	+
Ohio	2,806	1.	31	2.	62	1.	31	1.	31
Ind.	1,704	1.	18	1.	18	1.	18	t	+
Ill.	4,943	t	+	t	+	3.	171	.3	17
Mich.	6,434	0	0	t	+	0	0	t	+
Wis.	2,037	0	0	t	+	0	0	t	+
Minn.	1,365	*-	-	t	+	0	0	1.	15
Iowa	1,815	-	-	*-	-	*-	-	1.	19
Mo.	5,775	2.	133	3.	199	2.	133	t	+
N. D.	-	-	-	-	-	0	0	*0	0
S. D.	302	0	0	-	-	*-	-	t	+
Nebr.	1,125	t	+	*-	-	2.	27	2.	27
Kans.	1,835	t	+	t	+	3.	64	t	+
Ky.	1,480	1.5	24	3.	49	1.	16	2.	33
Tenn.	1,560	2.	44	5.	110	5.	110	2.	44
Ala.	617	7.	58	2.	17	8.	67	t	+
Miss.	-	1.	-	3.	-	5.	-	1	-
La.	-	t.	+	-	-	*-	-	*0	0
Texas	624	1.	7	1.	7	8.	57	*0	0
Okla.	1,512	t	+	2.	34	8.	136	*0	0
Ark.	4,250	5.	244	.5	24	2.	98	1.	49
Mont.	1,289	0	0	-	-	0	0	0	0
Colo.	3,418	0	0	t	+	0	0	*0	0
N. Mex.	1,329	*-	-	t	+	0	0	0	0
Ariz.	154	0	0	-	-	0	0	0	0
Utah	779	0	0	-	-	0	0	0	0
Ida.	4,350	0	0	-	-	0	0	0	0
Wash.	23,190	0	0	-	-	0	0	0	0
Ore.	5,579	0	0	-	-	0	0	0	0
Calif.	8,640	0	0	-	-	0	0	0	0
U. S.	147,457	1.21	2,019	1.36	2,260	.8	1,325	1.7	2,821

Estimated reduction in yield of apples due to fire blight (*Bacillus amylovorus*), scab (*Venturia inaequalis*), and other diseases, 1919.

State	Production 1919 Bushels 000 omitted	Estimated reduction in yield due to disease. Fire blight %	Fire blight Bus. (000 omitted)	Scab %	Scab Bus. (000 omitted)	Other diseases %	Other diseases Bus. (000 omitted)	All diseases %	All diseases Bus. (000 omitted)
Me.	4,680	-	-	+	+	-	-	+	+
N. H.	1,510	t	+	5.	79	-	-	5. +	79+
Vt.	1,500	t	+	5.	80	-	-	6. +	96+
Mass.	3,240	t	+	1.	33	-	-	2. +	66+
R. I.	294	t	+	2.	6	-	-	3. +	9+
Conn.	1,572	t	+	2.	33	-	-	4. +	66+
N. Y.	16,800	t	+	10.	1,931	2.	386	13. +	2,510+
N. J.	2,313	1.	24	-	-	-	-	5.5+	134+
Pa.	7,972	1.	101	10.	1,009	4.	404	21.	2,119
Del.	750	t	+	5.	41	-	-	8. +	65+
Md.	1,944	t	+	4.	85	-	-	8.5+	181+
Va.	9,950	.5	73	4.	581	3.	436	31.5	4,576
W. Va.	3,478	1.	40	3.	120	-	-	13. +	520+
N. C.	1,108	10.	185	4.	74	-	-	40.	739
S. C.	700	10.	135	1.	13	-	-	48.	646
Ga.	636	12.	128	1.5	16	4.	43	40.5+	433+
Ohio	2,806	.5	16	4.	124	-	-	9.5	295
Ind.	1,704	t	+	3.	55	1.	19	7. +	128+
Ill.	4,943	t	+	6.	342	4.	228	13.3+	758+
Mich.	6,484	t	+	8.	564	-	-	8. +	564+
Wis.	2,087	1.	23	8.	186	1.	23	10. +	232+
Minn.	1,365	1.	15	5.	74	1.	15	8. +	119+
Iowa	1,815	t	+	4.	76	-	-	5. +	95+
Mo.	5,773	1.	66	3.	199	2.	133	13. +	863+
N. D.	-	t	+	-	-	-	-	+	+
S. D.	302	*-	-	8.	26	-	-	8. +	26+
Nebr.	1,125	t	+	8.	107	4.	53	16. +	214+
Kans.	1,835	1.	21	8.	171	2.	43	14. +	299+
Ky.	1,480	2.	33	-	-	-	-	9.5+	155+
Tenn.	1,560	5.	110	10.	219	t	+	29. +	637+
Ala.	617	5.	42	4.	33	-	-	26. +	217+
Miss.	-	5.	-	t	+	-	-	15. +	+
La.	-	*-	-	t	+	-	-	+	+
Texas	624	2.	14	-	-	-	-	12.	85
Okla.	1,512	t	+	t	+	1.	17	11. +	187+
Ark.	4,250	1.	49	.5	21	3.	127	13.	635
Mont.	1,289	t	+	t	+	-	-	+	+
Colo.	3,418	*-	-	t	+	-	-	+	+
N. Mex.	1,329	t	+	0	0	-	-	-	-
Ariz.	152	.5	1	0	0	-	-	.5+	1+
Utah	779	-	-	-	-	-	-	-	-
Idaho	4,350	1.	44	.2	9	5.	232	6.2	287
Wash.	23,190	t	+	.5	119	2.	464	2.5+	595+
Ore.	5,579	.5	29	2.	115	1+	56+	3.5+	202+
Calif.	8,640	-	-	-	-	1.	87	1.	87
U. S.	147,457	.69	1,151	4.43	6,544	1.63	2,400	11.57	16,920

THE PLANT DISEASE BULLETIN

Issued By

THE PLANT DISEASE SURVEY

SUPPLEMENT 13

Index to Supplements 8 - 12

December 31, 1920

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1920

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ERRATA AND EXPLANATION

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48	Read "*Gibberella saubinetii*" instead of "*Gibberella saubinettii*".
57	Read "*Gibberella saubinetii*" instead of "*Gibberella saubinettii*".
69	Alfalfa, read "*Medicago sativa*" instead of "*Medicaco sativa*".
171	Cranberry, read "*Exobasidium vaccinii*" instead of "*Exobasisium vaccinii*".
189	Read "*Fusarium oxysporum*" instead of "*Fusarium oxysporium*".
204	Read "*Cystospora batata*" instead of "*Cyptospora batata*".
222	Read "*Fusarium batatatis*" instead of *Fusarium batatis*".
240	Horseradish, read "*Alternaria brassicae*" instead of"*Alternaira brassicae*".
297	Sequoia, read "*Botrytis douglasii*" instead of "*Botrytis douglassi*".
300	Evonymus, read "*Exosporium concentricum*" instead of"*Exosporium concentrichum*".
305	Read "*Lactuca pulchella*" instead of "*Lactuca pulchelia*".
325	Read "*Fusarium batatatis*" instead of *Fusarium batatis*".
329	Read "*Colletotrichum gossypii*" instead of "*Colletotrichum gossypsii*".

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